FINAL

INSTALLATION RESTORATION PROGRAM

CLOSURE INVESTIGATION REPORT
SITE 1 - FORMER BASE LANDFILL

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

VOLUME I OF II

APRIL 1997

AIR NATIONAL GUARD

Prepared For
AIR NATIONAL GUARD READINESS CENTER
ANDREWS AFB, MARYLAND 20762-5157

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TABLE OF CONTENTS

VOLUME I OF II

LIST OF APPENDICES iv
LIST OF FIGURES v
LIST OF TABLES vi
LIST OF ACRONYMS/ABBREVIATIONS vii

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1-1
1.1 Objectives 1-1
1.2 Scope and Methodology 1-1
1.3 Report Format 1-1

2.0 SITE BACKGROUND 2-1
2.1 Base Description and History 2-1
2.2 Site Description 2-3
2.3 Waste Depositional History 2-3
2.4 Summary of Previous Investigations 2-3
2.4.1 NUS Investigation, 1984 2-3
2.4.2 Dames & Moore Investigations, 1983 to 1986 2-5
2.4.3 Site Inspection, E.C. Jordan, 1988 2-5

3.0 ENVIRONMENTAL SETTING 3-1
3.1 Site Physiography and Topography 3-1
3.2 Regional/Local Geology 3-1
3.2.1 Bedrock Geology 3-6
3.2.2 Surficial Geology 3-6
3.3 Soils 3-7
3.4 Surface Hydrology 3-9
3.5 Regional/Local Hydrogeology 3-9
3.6 Groundwater Usage 3-12
3.7 Climate 3-14
3.8 Ecology 3-14

4.0 FIELD PROGRAM 4-1
4.1 Summary 4-1
4.1.1 Objectives 4-1
4.1.2 Approach 4-1
4.2 Deviations from the Work Plan 4-8
4.3 Field Investigation Activities 4-8
4.3.1 Explosive Gas Investigation 4-8

4.3.2 Leachate Investigation 4-9
4.3.3 Test Pit Excavation 4-10
4.3.4 Soil Borings 4-10
4.3.5 Monitoring Well Installation and Development 4-10
4.3.6 In-situ Aquifer Testing 4-12
4.3.7 Groundwater Sampling 4-12
4.3.8 Surface Water Sampling 4-12
4.3.9 Vector Survey/Wetlands Delineation 4-13
4.3.10 Evaluation of Slope Stability 4-13
4.3.11 Evaluation of Settlement Characteristics 4-13
4.3.12 Side Slope Soil Sampling and Permeability Evaluation 4-16
4.3.13 Surveying 4-16

5.0 INVESTIGATION FINDINGS 5-1
5.1 Site Geologic and Hydrologic Investigation Results 5-1
5.1.1 Geology 5-1
5.1.1.1 Surficial Geology 5-1
5.1.1.2 Bedrock Geology 5-8
5.1.2 Hydrogeology 5-11
5.1.2.1 Horizontal Flow and Gradients 5-15
5.1.2.2 Vertical Gradients 5-20
5.1.2.3 Effective Porosity 5-25
5.1.2.4 Hydraulic Conductivity 5-27
5.1.2.5 Average Linear Velocity 5-27
5.1.3 Surface Water Hydrology 5-30
5.2 Background Sampling Results 5-30
5.3 Site Findings 5-31
5.3.1 Explosive Gas Investigation Results 5-31
5.3.2 Leachate Investigation Results 5-35
5.3.3 Test Pit Excavation Results 5-35
5.3.4 Groundwater Sampling Results 5-37
5.3.5 Surface Water Sampling Results 5-41
5.3.6 Vector Survey/Wetland Delineation Results 5-44
5.3.7 Slope Stability Evaluation Results 5-44
5.3.8 Settlement Characteristics Evaluation Results 5-49
5.3.9 Side Slope Soil Sampling and Permeability Evaluation Results . . 5-50
5.4 Summary 5-53
5.4.1 Geology and Hydrogeology 5-53
5.4.2 Explosive Gas Potential 5-54
5.4.3 Chemical Characterization Findings 5-55
5.4.4 Physical Characterization Findings 5-55

6.0 CONCLUSIONS 6-1

7.0 RECOMMENDATIONS 7-1

8.0 REFERENCES 8-1

LIST OF APPENDICES

VOLUME II OF II

Appendix A	Basewide Site Inspection Data
Appendix B	Field Change Requests
Appendix C	Test Pit Logs
Appendix D	Boring Logs
Appendix E	Monitoring Well Construction Logs
Appendix F	Water Level Data and Calculations
Appendix G	Aquifer Testing Data and Analyses
Appendix H	Chain of Custody Forms
Appendix I	Laboratory Data Summary Packages
Appendix J	Data Usability Report
Appendix K	Results of Vector Survey
Appendix L	Grain Size Analysis Results

LIST OF FIGURES

FIGURE		PAGE
2-1	Site Location Map	2-2
2-2	Location of Site 1	2-4
2-3	Site Inspection Sample Locations	2-6
2-4	Geophysical Survey Traverse Locations	2-10
3-1	Physiographic Provinces of Orange County	3-2
3-2	Plan and Cross Sectional Views of Cut and Fill Operations Conducted in the 1940's	3-3
3-3	Geologic Map of the Newburgh, New York Area	3-4
3-4	General Stratigraphic Column	3-5
3-5	Soil Map	3-8
3-6	Base Stormwater Drainage Map	3-10
3-7	Areal Drainage Map	3-11
3-8	SI Groundwater Contours for Sites 1 & 2	3-13
3-9	Municipal Water Supply Distribution	3-15
4-1	Sample Locations	4-11
4-2	Slope Stability Monument Locations	4-14
4-3	Settlement Pad Locations	4-15
4-4	Soil Grain Size Sample Locations	4-17
5-1	Cross Section Location Map	5-2
5-2	Hydrogeologic Cross Section A-A'	5-3
5-3	Hydrogeologic Cross Section B-B'	5-4
5-4	Hydrogeologic Cross Section C-C'	5-5
5-5	Hydrogeologic Cross Section D-D'	5-6
5-6	Hydrogeologic Cross Section E-E'	5-7
5-7	Bedrock Geology Map	5-10
5-8	Topographic Lineament Analysis	5-12
5-9	Water Table Contour Map 4/9/96	5-16
5-10	Bedrock Groundwater Contour Map 4/9/96	5-17
5-11	Water Table Contour Map 8/15/96	5-18
5-12	Bedrock Groundwater Contour Map 8/15/96	5-19
5-13	Flow Net Cross Section D-D'	5-22
5-14	Flow Net Cross Section E-E'	5-23
5-15	Results of Explosive Gas Investigation	5-34
5-16	Test Pit Locations	5-36
5-17	Groundwater Analysis Summary	5-40
5-18	Surface Water Analysis Summary	5-43
5-19	Wetland Boundary Locations	5-45
7-1	Preliminary Conceptual Grading Plan - Recommended Cover	7-3
7-2	Preliminary Conceptual Grading Plan - New York State Geomembrane Cover	7-4
7-3	Typical Cross Sectional View - Geomembrane Cover	7-5

LIST OF TABLES

TABLE		PAGE
2-1	Site Inspection Analytical Results	2-7
4-1	Planned and Executed Field Program Summary	4-2
4-2	Laboratory Analytical Program Summary	4-5
4-3	Summary of Analytical Methods	4-6
5-1	Top of Bedrock Elevation Summary	5-9
5-2	Well Construction Summary	5-13
5-3	Groundwater Elevation Summary	5-14
5-4	Vertical Gradient Comparison	5-21
5-5	Site Inspection Grain Size Analysis Distribution Summary	5-26
5-6	Summary of Slug Test Hydraulic Conductivity Data	5-28
5-7	Average Linear Velocity Estimates	5-29
5-8	Site 1 Groundwater Sample Analysis Summary - Background Samples	5-32
5-9	Site 1 Surface Water Sample Analysis Summary - Background Sample	5-33
5-10	Site 1 Groundwater Analysis Summary	5-38
5-11	Site 1 Surface Water Analysis Summary	5-42
5-12	Calculation of Slope Stability Monument Location Coordinates Baseline Survey -- Performed on July 17, 1995	5-46
5-13	Calculation of Slope Stability Monument Location Coordinates Second Round Survey -- Performed on October 18, 1995	5-47
5-14	Calculation of Slope Stability Monument Location Coordinates Third Round Survey -- Performed on July 29,1996	5-48
5-15	Elevation and Location Calculations for Settlement Pads Baseline Survey -- Performed December 7, 1995 - Prior to Loading	5-51
5-16	Elevation and Location Calculations for Settlement Pads Second Round Survey -- Performed July 22, 1997 - 7 Months After Loading	5-52

LIST OF ACRONYMS/ABBREVIATIONS

ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
ANEPTEK	Aneptek Corporation
ASTM	American Society for Testing and Materials
AW	Airlift Wing
AWQC	Ambient Water Quality Criteria
AWQS	Ambient Water Quality Standard
bgs	below ground surface
BOD	Biological Oxygen Demand
CI	Closure Investigation
cm/sec	centimeters per second
DOT	Department of Transportation
DWQS	Drinking Water Quality Standard
Dynamac	Dynamac Corporation
E	East
eV	electron-volts
E.C. Jordan	E.C. Jordan Company
Eh	Oxidation Potential
EPA	Environmental Protection Agency
°F	Degrees Fahrenheit
FID	Flame Ionization Detector
FS	Feasibility Study
ft	feet
ft/d	feet per day
ft/ft	feet per foot
gpm	gallons per minute
IAP	International Airport
ID	inside diameter
IRP	Installation Restoration Program
K	Hydraulic Conductivity
LEL	Lower Explosive Limit
MCL	Maximum Contaminant Level
μg/kg	microgram per kilogram
mg/L	milligrams per liter
μg/L	micrograms per liter
μg/dL	micrograms per deciliter
ml	milliliter
mm	millimeter
msl	mean sea level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTA	Metropolitan Transit Authority
N	North

NA	Not Applicable
NCDC	National Climatic Data Center
ND	Not Detected
n_e	effective porosity
NGB	National Guard Bureau
NI	Not Included
NOAA	National Oceanic and Atmospheric Administration
NP	Not Planned
NS	Not Specified
NUS	NUS Corporation
NYANG	New York Air National Guard
NYCRR	New York Codes, Rules, and Regulations
NYDOH	New York Department of Health
NYDWQS	New York Drinking Water Quality Standard
NYSDEC	New York State Department of Environmental Conservation
OD	outside diameter
OVA	Organic Vapor Analyzer
oz	ounce
ρ	bulk density
PA	Preliminary Assessment
ppm	parts per million
PVC	Polyvinyl Chloride
PCBs	Polychlorinated Biphenyls
QA/QC	Quality Assurance/Quality Control
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RQD	Rock Quality Designations
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Service
SI	Site Inspection/Investigation
SOP	Standard Operating Procedure
SPDES	State Pollutant Discharge Elimination System
SSM	Slope Stability Monument
TCA	1,1,1-trichloroethane
USAF	United States Air Force
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
$\mu g/L$	micrograms per liter
V_x	average linear velocity or seepage velocity
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

Background

A Closure Investigation (CI) of Site 1, the former Base Landfill at Stewart Air National Guard Base (the Base) located at the Stewart International Airport (IAP), was performed by Aneptek Corporation (ANEPTEK). Site 1 is located southeast of the airport complex. Site 1 and Site 2 (the former pesticide pit disposal area) have been the subject of several previous investigations by both the New York State Department of Environmental Conservation (NYSDEC) and the National Guard Bureau.

Scope of Investigation. The CI field program included air monitoring and the sampling of subsurface soils, surface water and groundwater to provide data for an evaluation of site geology, hydrogeology, and potential environmental impacts from the Site 1 landfill. All groundwater and surface water samples submitted for off-site laboratory analysis were analyzed for the full list of Baseline Parameters provide in Chapter 6 of the New York Codes, Rules, and Regulations (6 NYCRR) Part 360-2.11. Physical characteristics of the fill and cover material were defined through the installation and monitoring of slope stability monuments and settlement pads. Test pits were excavated to determine the lateral extent of waste. Soil samples collected from the existing interim cover were submitted to an off-site laboratory for grain size analyses. Slug tests were performed on monitoring wells to provide estimates of formation hydraulic conductivity. In accordance with the requirements of 6 NYCRR Part 360-2.15, an explosive gas investigation was conducted using a slam-bar and monitoring gasses with a flame ionization detector (FID) and a meter capable of detecting percent oxygen, percent lower explosive limit (LEL), carbon monoxide, and hydrogen sulfide. A complete site walkover of the landfill was made to locate any areas of leachate outbreak; and a vector survey was conducted by a field biologist.

Investigation Findings

Geology. Site 1 is underlain by a thick layer of very dense silty to clayey lodgement glacial till derived from the underlying bedrock, the upper portion of which has been weathered to less dense soil. The till varies in thickness from approximately 45 feet to the west of Site 1 to approximately 20 feet to the east of Site 1. Bedrock immediately underlying the till is composed of weathered, fractured, dark grey shale, with competency increasing with depth.

Hydrogeology. Groundwater flow in the study area is represented by two interconnected flow systems, an upper flow system in the overburden (till) and a lower system in the underlying weathered, fractured shale bedrock. The lodgement till appears to impede vertical flow, especially beneath Site 2 to the west of Site 1, where the unweathered portion of the till is very thick (greater than 20 feet).

Groundwater flows in both the overburden and bedrock to the east or east-southeast towards lower topographic elevations. In the overburden, groundwater flow originating from the vicinity

of Site 2 flows predominantly eastward and terminates in the vicinity of Murphy's Gulch. In the bedrock, a southeastern component of flow not observed in the overburden indicates that groundwater in the bedrock originating from Site 2 appears to flow toward the southern portion of the study area. In addition, radial flow indicated by the bedrock groundwater elevations west of Site 1 was observed. This is possibly induced by less dense backfill and surface runoff detention in the former burial pit at Site 2 which results in locally increased infiltration, causing a localized "mounding" condition. In most cases, vertical gradients were strongly downward west of Site 1. Strongly upward gradients were observed only in the vicinity of the wetlands west of Murphy's Gulch suggesting groundwater discharges to surface waters east of Site 1.

In the overburden, average horizontal linear or seepage velocity estimates range from 0.21 to 0.64 feet per day (ft/d). In the bedrock, estimates range from 0.30 to 2.42 ft/d. These estimates are based on a geometric mean hydraulic conductivity estimate in the overburden of 0.35 ft/d (1.23×10^{-4} centimeters per second [cm/sec]) and 0.22 ft/d (7.84×10^{-5} cm/sec) in the fractured bedrock. The relatively high average horizontal linear velocity estimates are due to both the high observed horizontal gradient and the estimated relatively low formation effective porosity of 1 to 10 percent in the overburden and 1 to 8 percent in the bedrock. Because vertical hydraulic conductivity may be lower than horizontal hydraulic conductivity by an order of magnitude or more, corresponding average vertical linear velocity would be correspondingly lower, since both vertical and horizontal hydraulic gradients exhibited similar values.

Explosive Gas Potential

Generation and migration of explosive gas does not appear to be a significant problem at the Site 1 landfill. Only one of three rounds of gas measurements confirmed the presence of explosive gasses. The identified area was found to be limited in areal extent, as the relatively dense subsurface soils beneath the waste fill prevent subsurface gas migration to the west of the landfill. The less compacted, vegetated side slope may also be allowing gas generated to vent to the atmosphere, preventing build up of hazardous concentrations of such gas.

Chemical Characteristics

Minimal impact from the Site 1 landfill on groundwater and surface water quality was evident. No instances of leachate outbreaks were noted over the landfill or in the area between the landfill and nearby Murphy's Gulch, to the east. Collection and analysis of 12 groundwater samples indicated the presence of iron, manganese, and sodium at concentrations above drinking water standards and background concentrations in groundwater. One detection of 1,1,1-trichloroethane at 6 micrograms per liter (μg/L) was encountered in MW-07 which exceeded the New York State drinking water standard of 5 μg/L. However, this concentration is well below the Federal Maximum Contaminant Level (MCL) of 200 μg/L. Analysis of three surface water samples collected from the nearby Murphy's Gulch identified the presence of aluminum, iron, manganese, and zinc at concentrations above ambient water quality standards and concentrations detected in the upstream sample.

Physical Characteristics

The Site 1 landfill covers an area of approximately 8.5 acres as opposed to the 14 acres estimated during previous investigations. Waste materials contained within the landfill are typical of municipal waste (i.e., wood, soda cans, paper, plastic bags, metallic debris, etc.). No significant existing vector problem was identified at the Site 1 landfill.

Although the eastern slope of the landfill exceeds a 33 percent slope in places, the fill material appears to be stable under current conditions. Monitoring of slope stability monuments over a one year period did not identify any areas of significant movement in the fill material. Monitoring of the three settlement pads, loaded to approximately two to three times the load of a typical landfill cover, did not indicate any measurable settlement over a seven month period, including a full freeze-thaw cycle.

Recommendations

The initial recommendation for the Site 1 landfill was that a modified landfill cover be placed on a portion of the fill material in accordance with the New York State Part 360 Solid Waste Regulations. Through the application of variances and equivalent design, the recommended closure scenario would include placing an engineered cover over the western, flatter portions of the landfill, and leaving the thick vegetated side slope in its current condition. The Design Analysis Report submitted by ANEPTEK in June of 1996 contains a complete discussion of this recommended cover.

However, based upon recent conversations with representatives from NYSDEC it appears the approval process for the required variances and equivalent designs may cause significant delays in completing the design of the landfill closure. Also, it does not appear likely that all of the required approvals will be granted by NYSDEC, based on recent precedents set at other apparently similar landfill sites. Therefore, in the interest of avoiding significant project schedule delays it is recommended that a New York State geomembrane cover be placed over the entire landfill. Given the desired future use of the site (i.e., as a recreational softball field) it is further recommended that an equivalent design be requested, replacing the 12-inch gas venting layer with a geonet/geosynthetic fabric composite layer. This will reduce the amount of additional fill required to provide the relatively flatter ground surface slope required for a ballfield. Based on discussions with NYSDEC representatives, this equivalent design should be acceptable to the regulators.

SECTION 1.0

1.0 INTRODUCTION

This report presents the results of a Closure Investigation (CI) performed at Installation Restoration Program (IRP) Site Number 1 (Site 1), the former Base Landfill at the 105th Airlift Wing (AW), Stewart Air National Guard (ANG) Base located at Stewart International Airport (IAP), in the Towns of both Newburgh and New Windsor, New York. The Air National Guard Readiness Center (ANGRC) tasked Aneptek Corporation (ANEPTEK) to perform the CI of Site 1 under National Guard Bureau (NGB) Contract No. DAHA90-93-D-0003, Delivery Order No. 08.

The CI program was initiated at a scoping/kick-off meeting held at Stewart ANG Base (the Base) on October 28, 1994, which was attended by officials from ANGRC, the 105th AW, the New York State Department of Environmental Conservation (NYSDEC) and ANEPTEK. At the meeting, regulatory requirements, planning, logistics and responsibilities were defined. Subsequently, ANEPTEK submitted a CI work plan which was approved by ANGRC and NYSDEC on August 17, 1995. ANEPTEK initiated the first of three field mobilizations in June, 1995. The second mobilization was initiated during August, 1995. The final field mobilization was initiated in July, 1996 and the CI field program was completed during August, 1996.

1.1 Objectives

The purpose of this CI was to satisfy the closure investigation requirements of Chapter 6 of the New York Codes, Rules, and Regulations (6 NYCRR) Part 360-2.15 for Site 1, and to obtain sufficient data to support the engineering design of an appropriate landfill cover for Site 1.

1.2 Scope and Methodology

The CI field program included: excavating test pits to delineate the extent of fill material; installing groundwater monitoring wells; sampling and analyzing groundwater and surface water samples for Baseline Parameters listed in 6 NYCRR Part 360-2.11, performing explosive gas, vector, and leachate investigations; and installing and monitoring slope stability monuments and settlement pads to evaluate the current stability of the waste. Site 1 has also been the subject of a previous Site Inspection (SI) performed for the NGB by E.C. Jordan Company (E.C. Jordan). A summary of this previous investigation is provided in Section 2.0.

1.3 Report Format

This CI report is divided into seven sections. Section 1.0 describes the objective and general methodology of the CI. Section 2.0 provides background information pertaining to Site 1 and the results of the previous SI. Section 3.0 describes the environmental setting of the Base and the surrounding area. Section 4.0 describes the CI field program. Section 5.0 presents the

investigation results including the physical characterization of the site and the results of all monitoring and chemical analyses performed. Sections 6.0 and 7.0 present a summary of the CI findings and the recommendations for landfill closure, respectively. Supplemental information obtained during the CI is presented in several appendices, as follows:

Appendix A	Basewide Site Inspection Data
Appendix B	Field Change Requests
Appendix C	Test Pit Logs
Appendix D	Boring Logs
Appendix E	Monitoring Well Construction Logs
Appendix F	Water Level Data and Calculations
Appendix G	Aquifer Testing Data and Analyses
Appendix H	Chain of Custody Forms
Appendix I	Laboratory Data Summary Packages
Appendix J	Data Usability Report
Appendix K	Results of Vector Survey
Appendix L	Grain Size Analysis Results

SECTION 2.0

2.0 SITE BACKGROUND

This section presents brief background summaries of the Base (Section 2.1) and the site (Section 2.2), as well as findings from the previous SI (Section 2.3).

2.1 Base Description and History

The Base is located at the Stewart IAP (Figure 2-1), approximately 2.5 miles west of the City of Newburgh, New York (Figure 2-1). The airport property occupies approximately 9,800 acres in Orange County. The Base facilities are located in both the Towns of Newburgh and New Windsor, New York. According to the 1990 Census, Orange County had a population of 307,647. The City of Newburgh, the Town of Newburgh, and the Town of New Windsor have populations of 26,454, 24,058, and 22,937, respectively.

Stewart IAP includes a number of landing strips, taxiways and airport support service areas, in addition to the New York ANG Base facilities. The airport facilities are zoned for Industrial usage in the Town of Newburgh, and Airport usage in New Windsor. The Base facilities in Newburgh are bounded on the west and northwest by Industrial Zones, and on the north and east by Interchange Business Zones. In New Windsor, the Base is bounded on the south and southwest by Airport Zones, on the southeast by Planned Industrial Zones, and to the east by Office and Light Industrial Zones. Residential housing is scattered throughout most of these areas (E.C. Jordan, 1989).

The Base is located on property that was originally donated to the City of Newburgh in 1930 for use as a municipal airport. Before that time, the majority of the land was used for agricultural purposes. In 1941, a pilot training facility was constructed for cadets attending the U.S. Military Academy at West Point. From 1941 to 1969, the U.S. Air Force operated the facility as Stewart Air Force Base out of which B-57, F-100, and C-119 aircraft were flown. The aviation facilities were turned over to the State of New York in 1969. The State of New York has had continuous fee ownership of the property since 1969. Civilian aircraft and U.S. Army C-12 and Helos aircraft were operated and maintained during this time. In 1982, operation of the airfield was taken over by the New York Metropolitan Transit Authority (MTA). From early 1983 to the present, the 105th AW has leased the southeastern corner of Stewart IAP from the New York State MTA. From 1983 to 1985, the unit flew and maintained Cessna O-2 aircraft. In July 1985, the 105th AW began flying the C-5A "Galaxy" aircraft. The Base continues to use these aircraft to conduct strategic airlift missions. A small contingent of the U.S. Marine Corps Reserve Airlift Command also uses a section of the Base for its air-refueling missions using the KC-130 "Hercules" aircraft.

PREPARED FOR NATIONAL GUARD BUREAU		ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 W. Central Street, Natick, MA 01760	TITLE FIGURE 2-1 SITE LOCATION MAP STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK
DATE NOVEMBER 1, 1996	SCALE 1 IN. = 2000 FT.		
SOURCE E.C. JORDAN, 1989			

2.2 Site Description

Site 1 is located southeast of the airport complex. The site was the location of the former Base landfill which received municipal domestic wastes from former on-site residents during the 1960's and 1970's when the United States Air Force (USAF) occupied the Base. The location of Site 1 at the Base is shown in Figure 2-2. Site 1 is located adjacent to a main access route on the Base and access is unrestricted. The Stewart ANG Base Environmental Management Office, a softball field, parking areas and a recently-constructed automotive maintenance facility are located close to Site 1 and Site 2.

2.3 Waste Depositional History

After performing an exhaustive records search, detailed records of landfill waste depositional history were not found. However, based upon verbal accounts of past Base operations a general history of waste deposition has been developed. From approximately 1963 through 1968, a larger population consisting of active USAF Base employees and on-Base residents contributed to waste deposition. The USAF left the Base during the years 1969 and 1970. After that time, there was a lesser population density since there were no longer any on-Base residents. For the period of two years around the time of the departure of the USAF, the rate of waste deposition was significantly higher due to deposition of wastes resulting from active Air Force Base closure operations. The landfill continued to receive waste at a lower rate until around 1978. At that time, the landfill reportedly stopped receiving waste. However, the landfill was still open and probably continued to receive some waste until it was officially closed around 1982.

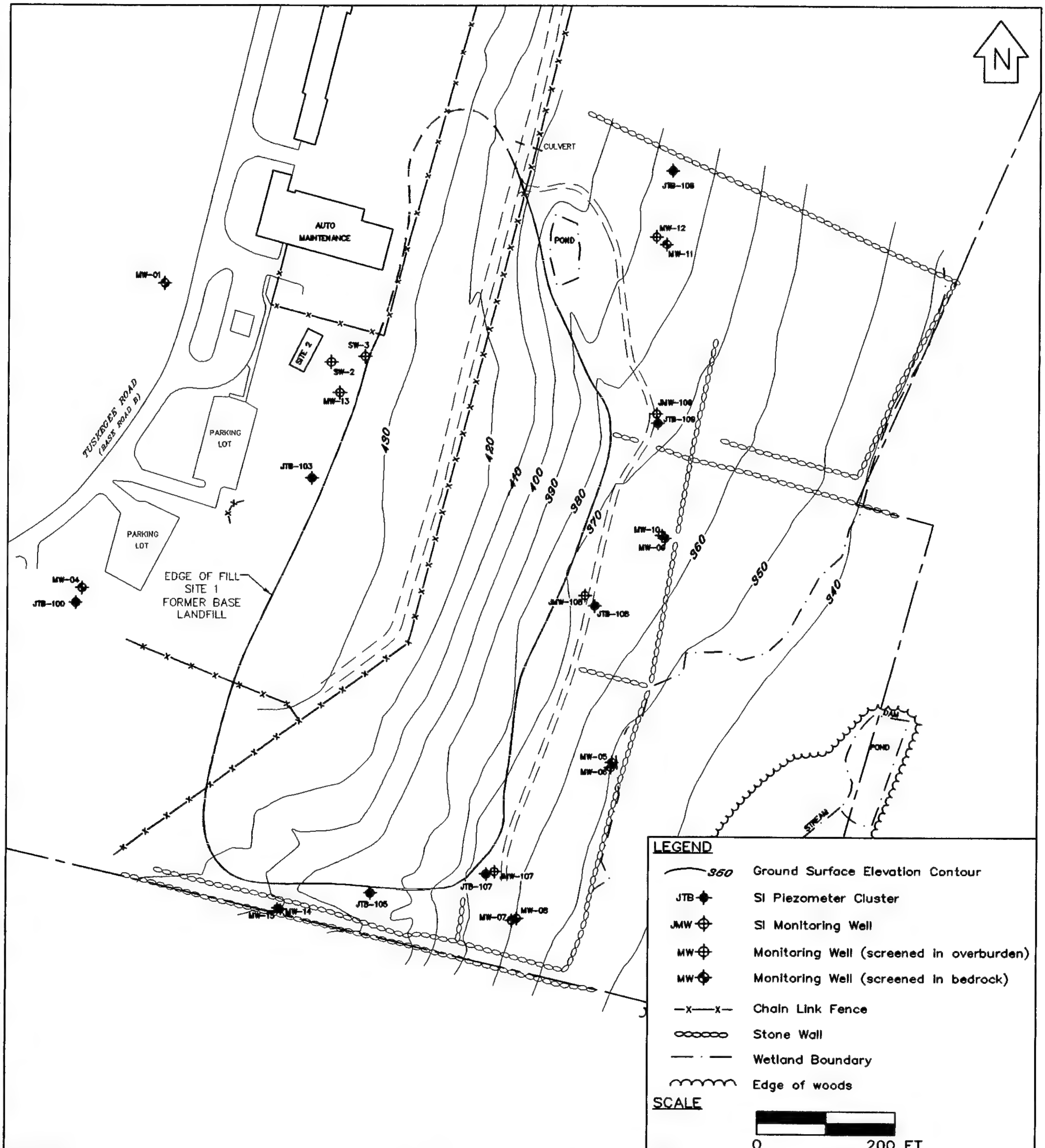
Based upon available information, the approximate volume of waste contained in the landfill is estimated to be 104,350 cubic yards. Details regarding the methodologies followed in calculating this estimated volume, including cross sections and calculations are provided in the Design Analysis Report (ANEPTEK, 1996). The depth of waste in the landfill varies from relatively thin layers toward the outer edges to a maximum near the current break in slope of the existing landfill topography. The maximum depth of waste placed into the landfill is estimated to be 22.5 feet.

2.4 Summary of Previous Investigations

Site 1 was the subject of several previous investigations and one removal action. The following discussion presents a summary of the scope and results of previous activities conducted at Site 1 as well as the data gaps and recommendations of the SI Report (E.C. Jordan, 1989).

2.4.1 NUS Investigation, 1984

In January 1984, NUS Corporation (NUS) evaluated groundwater, surface water, soil, and sediment in the vicinity of the Site 1. Based on the results of this effort, NUS made the following conclusions (E.C. Jordan, 1989):



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TITLE
FIGURE 2-2
LOCATION OF SITE 1

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

- The City of Newburgh's drinking water and water supply (Washington Lake) are free of hazardous substance contamination.

- Drinking water from private wells in the Town of New Windsor in the vicinity of the Stewart/USAF Base landfill and adjacent pesticide burial site area and the New Windsor Landfill are free of hazardous substance contamination.

- Surface water and sediments from Silver Stream, from its tributary origin at Stewart IAP to its diversion into the southern end of Washington Lake, are essentially free of hazardous substance contamination. Surface water, stream sediment, and soils in the vicinity of the Stewart/USAF Base landfill and adjacent pesticide burial site, and the New Windsor Landfill contain several volatile organic compounds (VOCs) and pesticides; these compounds may have an impact on Murphy's Gulch downstream of the landfills.

2.4.2 Dames & Moore Investigations, 1983 to 1986

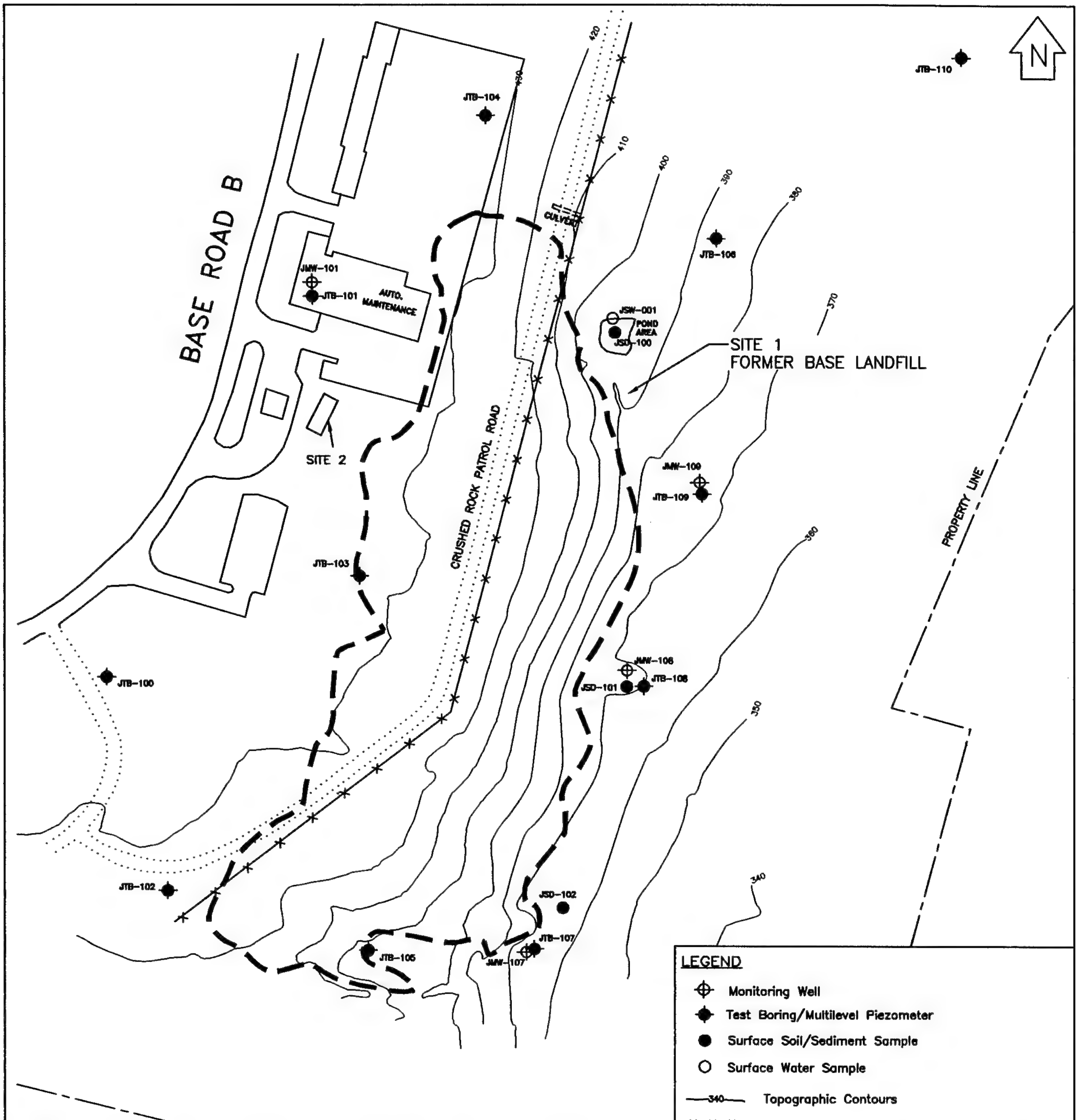
From September 1983 to March 1986, Dames & Moore performed a series of investigations in the area of Sites 1 and 2. These investigations included the excavation of test pits and the installation of groundwater monitoring wells. However, these investigations focused more on Site 2 than Site 1.

In 1988 an interim excavation and removal action was undertaken at Site 2. As a result of this interim action, 105 5-gallon drums and 13 55-gallon drums were removed and the excavation backfilled to grade. During the removal action it was observed that most of the containers were punctured and empty. One drum removed appeared to have contained used motor oil (Dynamac Corporation [Dynamac], 1988). The contents of the other drums was not able to be determined. Site 2 is the subject of an ongoing Remedial Investigation/Feasibility Study (RI/FS) being performed by NGB.

2.4.3 Site Inspection, E.C. Jordan, 1988

In 1988, E.C. Jordan performed an SI of Sites 1 and 2 to confirm and quantify environmental contamination. The SI consisted of a magnetometer survey around the perimeter of the fill material, a terrain conductivity survey downgradient of the fill material, subsurface explorations at 11 locations, installation of 25 piezometers and 4 groundwater monitoring wells, and collection of 1 surface water sample, 3 soil/sediment samples, and 8 subsurface soil samples ranging from 4 to 31 feet below ground surface (bgs). SI sampling locations are shown in Figure 2-3. Analytical results relevant to Sites 1 and 2 are listed in Table 2-1.

The magnetometer survey consisted of a series of traverses, running approximately perpendicular to the landfill boundary, spaced approximately 50 to 100 feet apart, and covering the entire perimeter of the landfill. Over each traverse, measurements were taken every 10 feet. The results of the magnetometer survey were interpreted to locate the approximate location of the extent of fill material in all directions, as illustrated in Figure 2-4. The raw data obtained from



NOTES

Buildings, parking lots and Base Road B digitized from map entitled "Stewart Airport — Auto Maint, New York Air National Guard, Newburgh, New York, dated May 1, 1989".

PREPARED FOR			TITLE
NATIONAL GUARD BUREAU		ANEPTEK CORPORATION 'Analytic, Environmental and Process Technologies 209 W. Central Street, Natick, MA 01760	FIGURE 2-3 SITE INSPECTION SAMPLE LOCATIONS
DATE NOVEMBER 1, 1996	SCALE 1 IN. = 200 FT.		
SOURCE E.C.JORDAN, 1989			STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK

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TABLE 2-1
SITE INSPECTION ANALYTICAL RESULTS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE LOCATION	JMW-101	JMW-107	JMW-108	JMW-109	JTB-102	JTB-103	JTB-105	JTB-106
SAMPLE IDENTIFICATION	JMW1013101	JMW1070401	JMW1080701	JMW1090501	JTB1021201	JTB1030501	JTB1050701	JTB1060501
MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
PARAMETER								
PCBs (µg/kg)								
Aroclor-1254	210	ND	ND	ND	210	ND	ND	ND
INORGANICS (mg/kg)								
Aluminum	8,140	7,810	7,510	9,220	8,190	7,940	NA	7,950
Arsenic	3.4 N	ND	2.3 N N	ND	3.1 N	ND	NA	2.5 N
Barium	52	ND	ND	ND	ND	ND	NA	41
Cadmium	ND	ND	ND	ND	ND	ND	NA	1.4
Calcium	30,900	1,800	2,120	2,490	25,500	28,300	NA	4,690
Chloride	39	ND	25	ND	40	14	21	ND
Chromium	11	11	11	12	11	11	NA	24
Copper	25 E	6.7	20	24 E	27 E	28 E	NA	6.7
Fluoride	ND	0.44	3.5	1.8	ND	ND	ND	0.29
Iron	18,800	17,700	17,800	21,400	19,400	18,500	NA	18,100
Lead	9.5 N	9.6 N	8 N	20	7 N	9.2 N	NA	14 N
Magnesium	5,830 E	3,370 E	3,250	3,820 E	6,150 E	4,070 E	NA	3,470 E
Manganese	790	594	504	999	471	575	NA	595
Mercury	ND	ND	0.13 N	0.11 N	0.12 N	ND	NA	ND
Nickel	13	11	12	17	ND	16	NA	12
Percent Soilds	87	87	90	88	90	89	93	84
pH	9.3	7.5	8	7.2	9.2	8.9	7.7	6.9
Potassium	ND	883	ND	ND	ND	ND	NA	837
Sulfate	1,100	ND	ND	ND	590	ND	66	ND
Vanadium	12	ND	ND	14	12	12	NA	12
Zinc	117	54	ND	ND	ND	ND	NA	48

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04/17/97

TABLE 2-1 (cont.)
SITE INSPECTION ANALYTICAL RESULTS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE LOCATION	JMW-101	JMW-101	JMW-107	JMW-108	JMW-108	JMW-108	JMW-108	JMW-106
SAMPLE IDENTIFICATION	JMW101XX01	JMW101XX01	JMW107XX01	JMW108XX01	JMW108R101	JMW108R201	JMW108R301	JMW109XX01
MATRIX	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
PARAMETER								
VOCS (μg/L)								
1,1,1-Trichloroethene	ND	ND	8.6	ND	ND	ND	ND	ND
INORGANICS (mg/L)								
Calcium	306	128	204	212	210	213	211	128
Chloride	11	67	54	250	NA	NA	NA	68
Fluoride	0.16	0.16	0.1	0.12	NA	NA	NA	0.22
Iron	0.466	0.112	ND	0.154	0.206	0.131	ND	ND
Magnesium	89.9	17.8	19.4	27.7	27.3	28.1	27	17.7
Manganese	2.75	9.43	0.16	5.94	5.24	5.8	5.66	9.15
Mercury	ND	ND	ND	ND	ND	ND	0.0075	ND
pH	6.8	6.4	6.7	6.6	NA	NA	NA	6.5
Sodium	117	46.4	35.7	101	98.6	100	101	45.9
Sulfate	1,300	40	45	60	NA	NA	NA	40

ABBREVIATIONS
mg/kg - milligrams per kilogram
mg/L - milligrams per liter
ND - Analyzed for but not detected.
NA - Not analyzed (insufficient sample volume)
μg/kg - micrograms per kilogram
μg/L - micrograms per liter

DATA QUALIFIERS
E = Indicates a value estimated due to the presence of inteference.
N = Indicates spike sample recovery is not within control limits.

this survey are presented in Appendix A.

A terrain conductivity survey was performed downgradient of the landfill to attempt to identify any areas in which potential contaminant plumes of higher conductivity may be present in groundwater. The terrain conductivity survey was performed along two traverses which ran approximately parallel to the downgradient extent of the fill material. Line 1 was located approximately 100 feet from the toe of the landfill and Line 2 was located approximately 200 feet from the toe of the landfill as illustrated in Figure 2-4. Along each of these lines, measurements were taken every 20 feet. The results of this survey are presented in Figure 2-4. The raw data obtained during this survey are presented in Appendix A.

Areas of elevated conductivity readings were noted downgradient of the landfill. To further investigate these findings, monitoring wells JMW-107, JMW-108, and JMW-109 were installed. Soil samples were collected during the installation of these wells, and groundwater samples collected after installation was complete. Analysis of these soil and groundwater samples did not indicate the presence of a plume of highly conductive contaminants. Therefore, E.C. Jordan concluded that the elevated readings obtained during the terrain conductivity survey were related to surface runoff from the landfill and not indicative of a deeper groundwater plume.

SECTION 3.0

3.0 ENVIRONMENTAL SETTING

This section presents a description of the location and environmental setting in the vicinity of Site 1. Information provided in this section has been obtained through a review of available literature, records pertaining to Site 1, visual observations made by ANEPTEK during a pre-investigation site visit, and interviews with Base personnel familiar with the history of Site 1.

3.1 Site Physiography and Topography

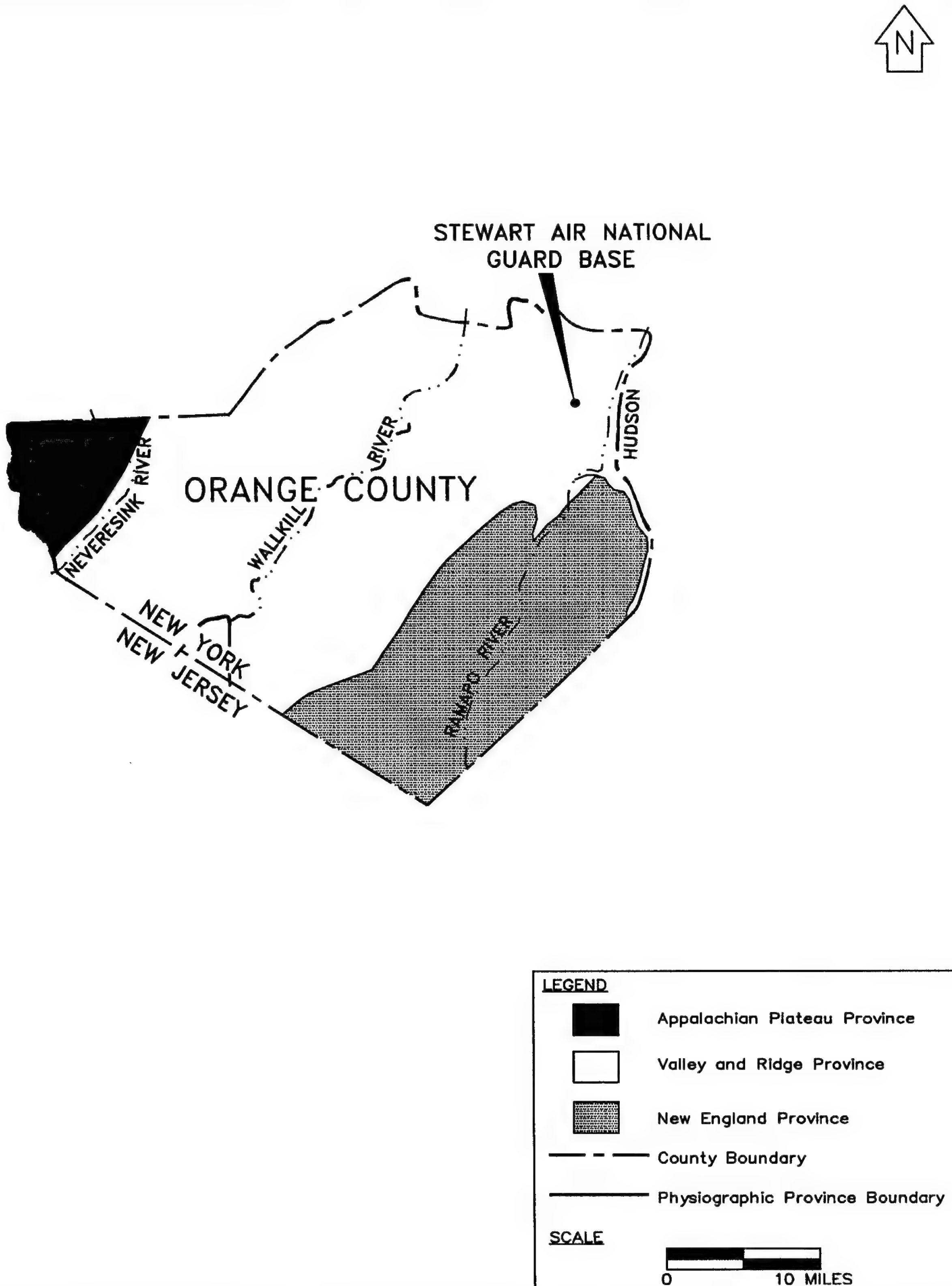
The site is located within the central portion of Orange County, within the Hudson-Champlain lowland of the Valley and Ridge Province (Frimpter, 1972) (Figure 3-1). The topography in the immediate vicinity of the base is gently to moderately rolling, consisting of drumlin hills shaped by successive advances of Pleistocene continental glaciations (Cadwell, 1989) (see also Section 3.2.2).

The site itself is located on the eastern side slope of a drumlin that was modified during construction of the Base (U.S. Army Corps of Engineers [USACE], 1943). The extent of topographic alteration in the vicinity of Site 1 is shown on Figure 3-2, which was derived from as-built grading plan record drawings obtained from the Stewart IAP Engineering Office (USACE, 1943). Figure 3-2 shows that prior to the expansion of the runways, a drumlin with a peak elevation greater than 525 feet above mean sea level (msl) existed on the eastern side of the Base. The east side of the Base was regraded to an elevation of approximately 440 feet msl during the expansion.

Existing grades on the Site 1 eastern side slope exceed 35 percent in some areas. Lesser grades are encountered along the northern portions of the landfill. To the east of the fill material, the topographic slope decreases towards Murphy's Gulch. Currently, there is extensive, developed vegetation established over the entire side slope of the site. This vegetation consists of numerous trees, thick brush and grass. The side slope resembles an early succession type wooded area with saplings and pole trees of birch, aspen and maple in addition to grass and brush. The age of this vegetation appears to be at least 15 years. At the toe of the landfill slope, there are numerous saw log size trees including walnut that are substantially older.

3.2 Regional/Local Geology

The geology of the Newburgh area is depicted in Figure 3-3. The general stratigraphic sequence below Site 1, shown in Figure 3-4, is based on literature information and data obtained during previous investigations. Logs for soil borings and rock cores advanced in the vicinity of Site 1 during previous investigations are provided in Appendix A. The soil boring and rock coring conducted during this investigation confirm this general stratigraphic sequence.



PREPARED FOR NATIONAL GUARD BUREAU		ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 W. Central Street, Natick, MA 01760	TITLE FIGURE 3–1 PHYSIOGRAPHIC PROVINCES OF ORANGE COUNTY STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK
DATE OCTOBER 31, 1996	SCALE 1 IN. = 10 MILES		
SOURCE FRIMPTER, 1972			

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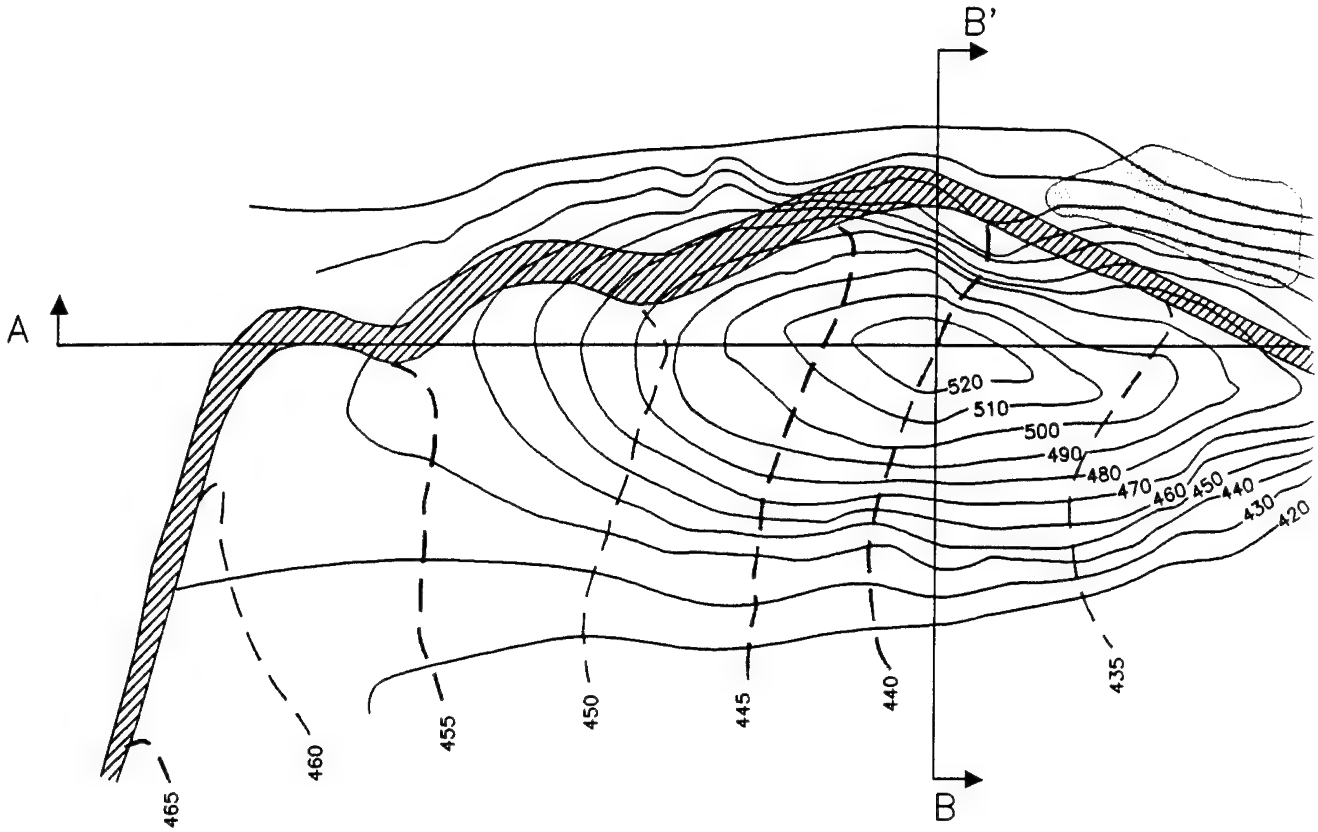
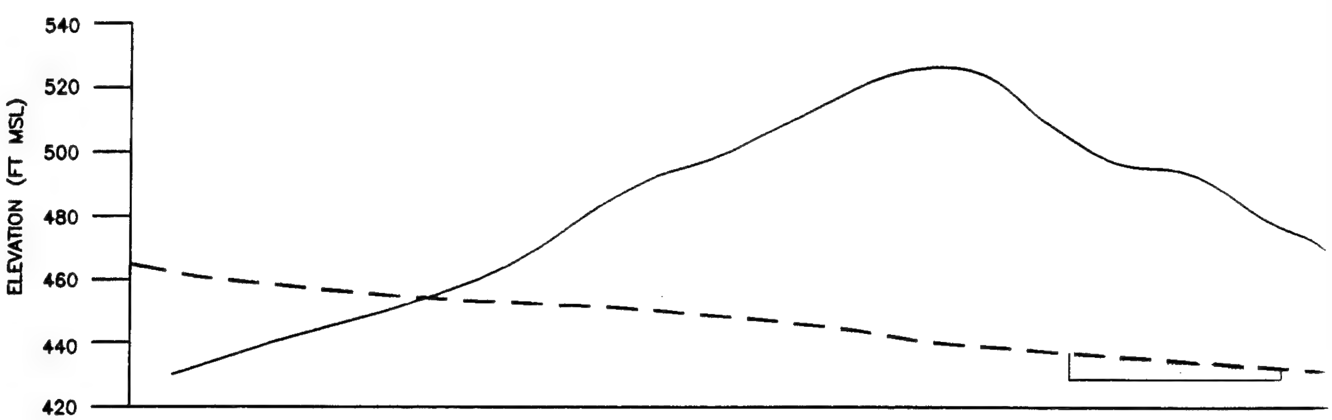


PLAN VIEW



CROSS SECTION A - A'

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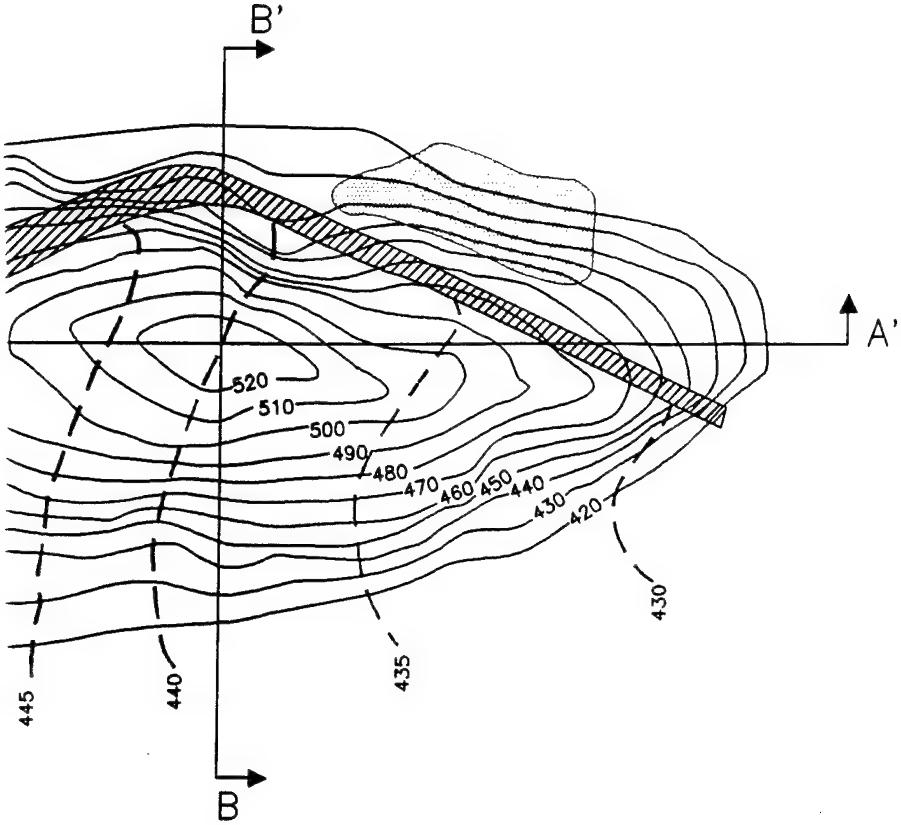
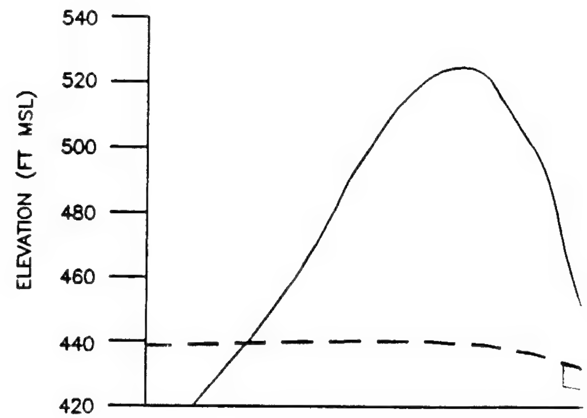


AN VIEW



CROSS SECTION B –

LEGEND

Former Grou
(ft msl)

Current Grou
(ft msl)

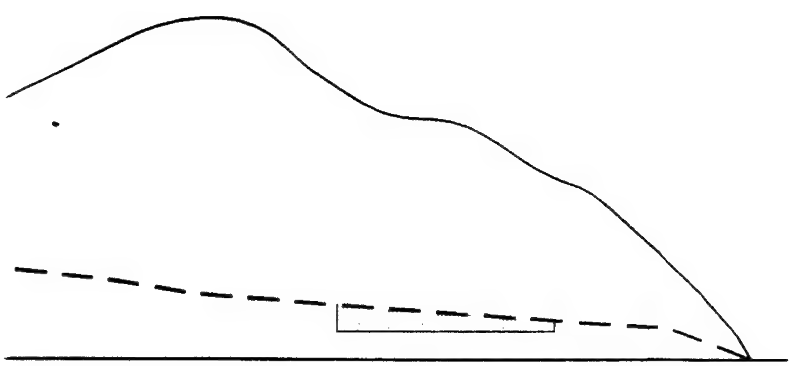
Approximate

ft msl Elevation in
sea level

Ditch

SCALE

Horizo
0
0
Vertic

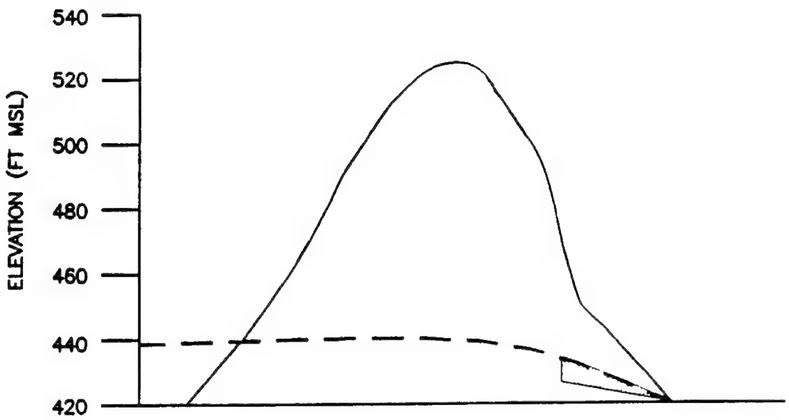


:CTION A – A'

TITLE	FIGURE 3- PLAN AND CROSS SECT AND FILL OPERATIONS CO STEWART AIR NATION NEWBURGH, NE
PREPARED FOR	NATIONAL GUARD BUREAU
DATE	OCTOBER 29, 1996
SOURCE	USACE, 1943

2

A'



CROSS SECTION B – B'

LEGEND

Former Ground Surface Elevation (ft msl)

Current Ground Surface Elevation (ft msl)

Approximate Location of Site 1

ft msl — Elevation in feet above mean sea level

Ditch

SCALE

Horizontal: 0 – 600 FT.

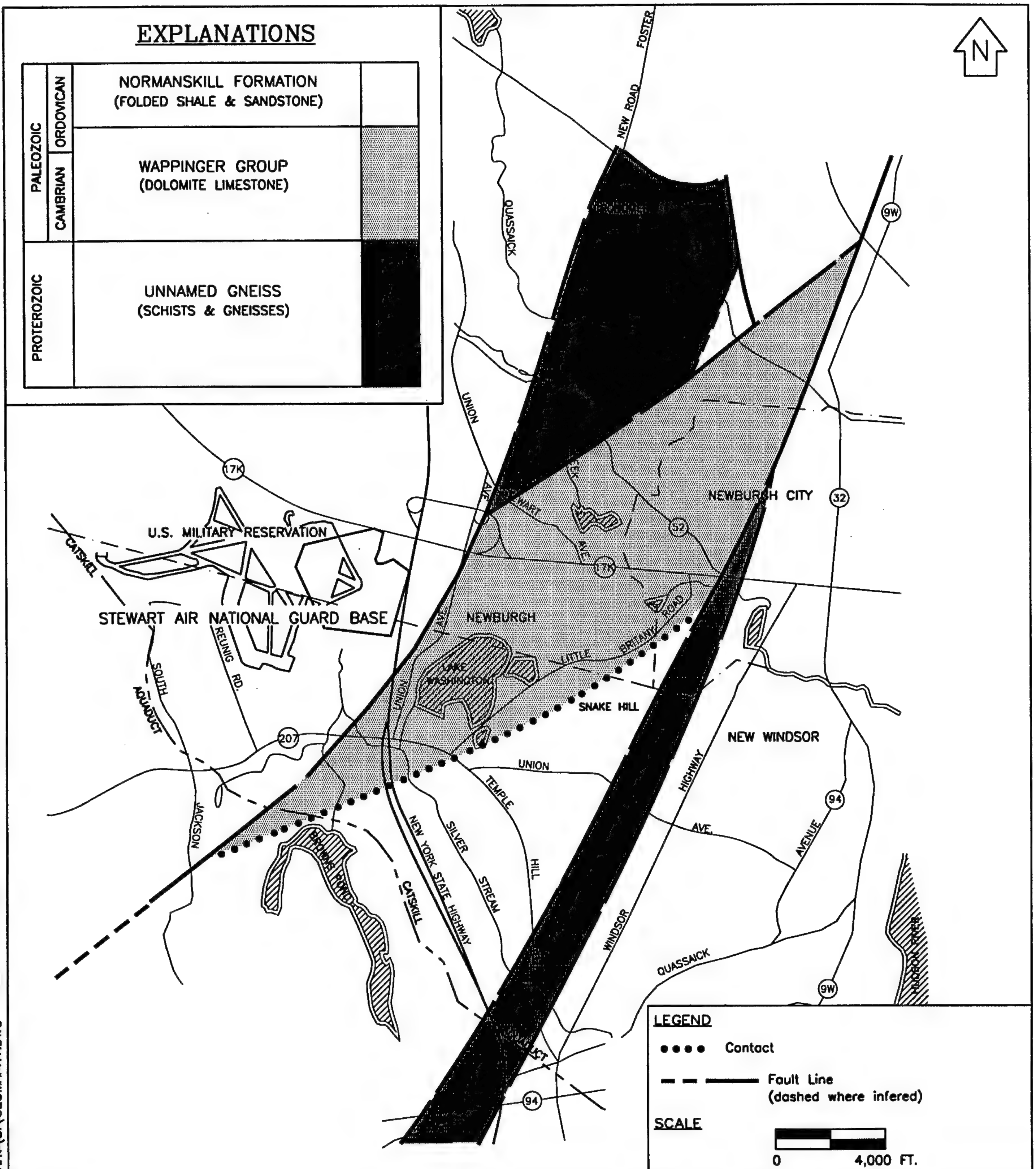
Vertical: 0 – 60 FT.

TITLE

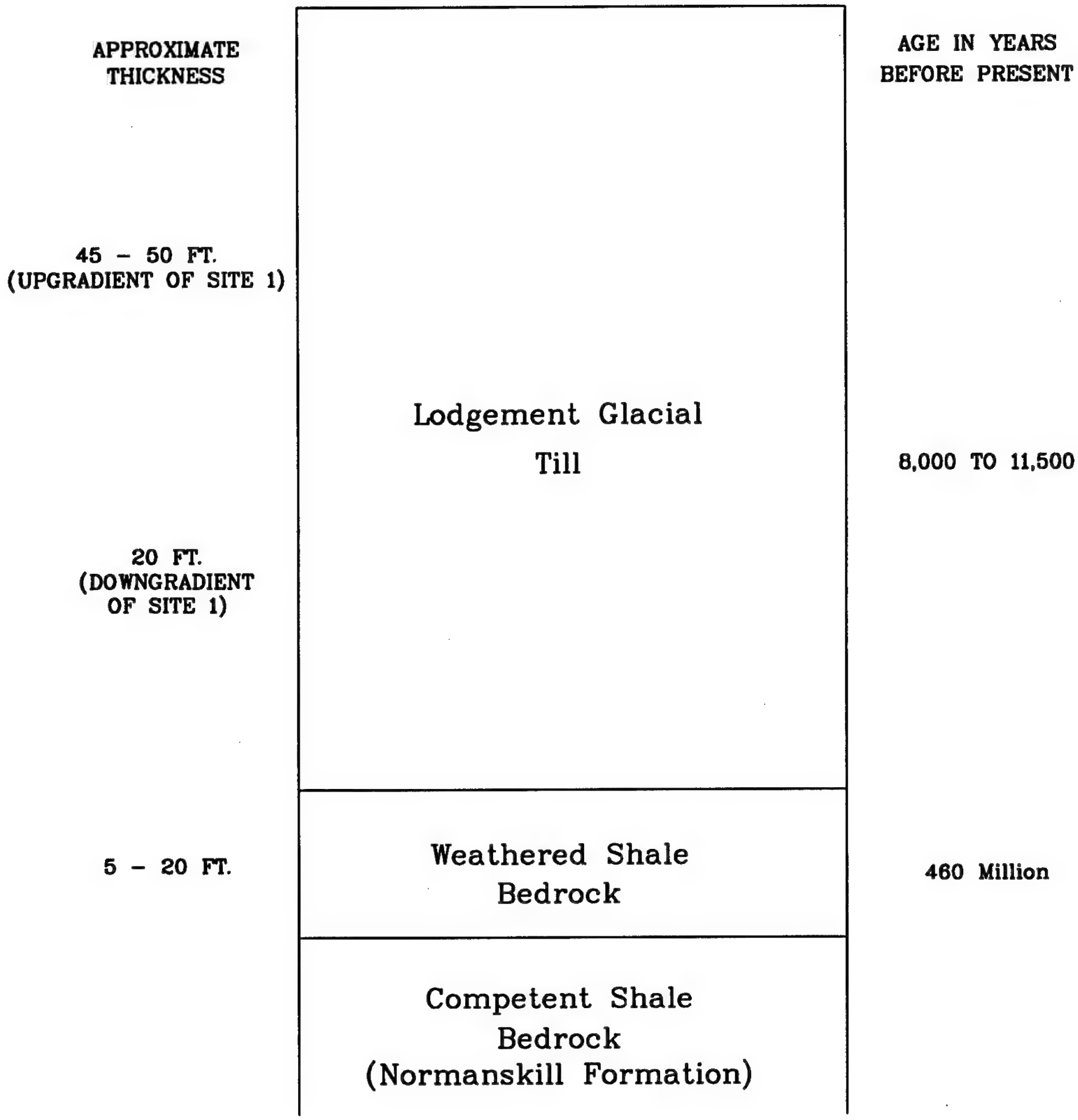
FIGURE 3–2
PLAN AND CROSS SECTIONAL VIEWS OF CUT AND FILL OPERATIONS CONDUCTED IN THE 1940's
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: HORIZONTAL: 1 IN. = 600 FT. VERTICAL: 1 IN. = 60 FT.
DATE: OCTOBER 29, 1996	ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 West Central Street, Natick, MA 01760
SOURCE: USACE, 1943	

3



PREPARED FOR		ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 W. Central Street, Natick, MA 01760	TITLE
NATIONAL GUARD BUREAU			FIGURE 3-3 GEOLOGIC MAP OF THE NEWBURGH, NEW YORK AREA
DATE OCTOBER 31, 1996	SCALE 1 IN. = 700 FT.		
SOURCE USGS QUADRANGLES, NEWBURGH, NY, 1957 AND CORNWALL, NY, 1981 AND FISHER ET. AT 1970			STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK



PREPARED FOR: NATIONAL GUARD BUREAU		ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 W. Central Street, Natick, MA 01760	TITLE: FIGURE 3-4 GENERAL STRATIGRAPHIC COLUMN STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK
DATE: OCTOBER 30, 1996	SCALE: NONE		
SOURCE: CADWELL, 1989; FISHER, 1970			

3.2.1 Bedrock Geology

Regional lithology of a large portion of the Hudson-Champlain Valley, which includes the Base, consists of alternating layers of soft shales, argillite, and sandstones (Fisher et. al., 1970). The shales comprise the youngest geologic unit in the area, and are referred to as the Normanskill Formation.

According to references cited in the SI (E.C. Jordan, 1989), regional bedrock structure consists of isoclinal folding throughout the formation, with the long axis trending north-northeast. Overturned folds are observed to the west. Bedding dips to the east, although a platey cleavage oriented 30 degrees from bedding is also observed. In addition, Figure 3-3 shows an interpreted thrust fault east of the Base, striking northeast, which placed Cambrian dolomites and Precambrian metamorphic rocks (schists and gneisses) of the Hudson Highlands over the younger Ordovician sedimentary rocks.

Previous investigations at Site 1 (Dames and Moore, 1986 and E.C. Jordan 1989) indicate that the bedrock is predominantly composed of the middle Ordovician age (450-425 million years before present), thinly bedded and fractured Martinsburg shale member of the Normanskill Formation (Fisher, et al., 1970). SI rock core logs describe these rocks as thinly laminated, gray to blackish shale with calcite lenses and veins with occasional layers of sandstone (E.C. Jordan, 1989). SI data indicate that in the vicinity of the eastern toe of the Site 1 side slope, the contact occurs at depths between 15 and 25 feet bgs, while upslope from Site 1, the top of bedrock occurs at depths between 45 and 50 feet bgs (Dames and Moore, 1986). Overlying the competent, unweathered shale is a zone herein referred to as weathered fractured shale, ranging from 2.5 to 10 feet thick (Dames and Moore, 1986). The upper portion of this zone is characterized by rock that has been weathered to the consistency of soil, grading downward to rock that is highly fractured, but exhibiting less chemical and physical weathering.

Based on SI rock cores, local bedrock structure is described as highly fractured and/or weathered to soil in the upper 10 feet below the overburden/bedrock interface, with competency (lack of fracturing and weathering) increasing with depth. Bedding observed in the SI cores is approximately 45 degrees from vertical, although one core showed lower angle bedding (70 degrees off the vertical). The SI stated that most fractures and core breaks are parallel and subparallel to observed bedding surfaces. Subvertical joint planes were observed in some cores. Evidence of faulting is observed in cores from the southerly and eastern portions of the SI study area (E.C. Jordan, 1989) in the form of highly fractured cores and/or slickensides.

3.2.2 Surficial Geology

According to Cadwell (1989), in the vicinity of the Base the overburden is primarily composed of lodgement (basal) till. Lodgement till consists of relatively low permeability, very dense, non-stratified, very poorly sorted clay to boulder sized material that was deposited at the base of advancing Pleistocene temperate or wet-based glaciers. It is derived from scouring, crushing and redeposition of pre-existing topographically exposed soil and rock under tremendous pressure.

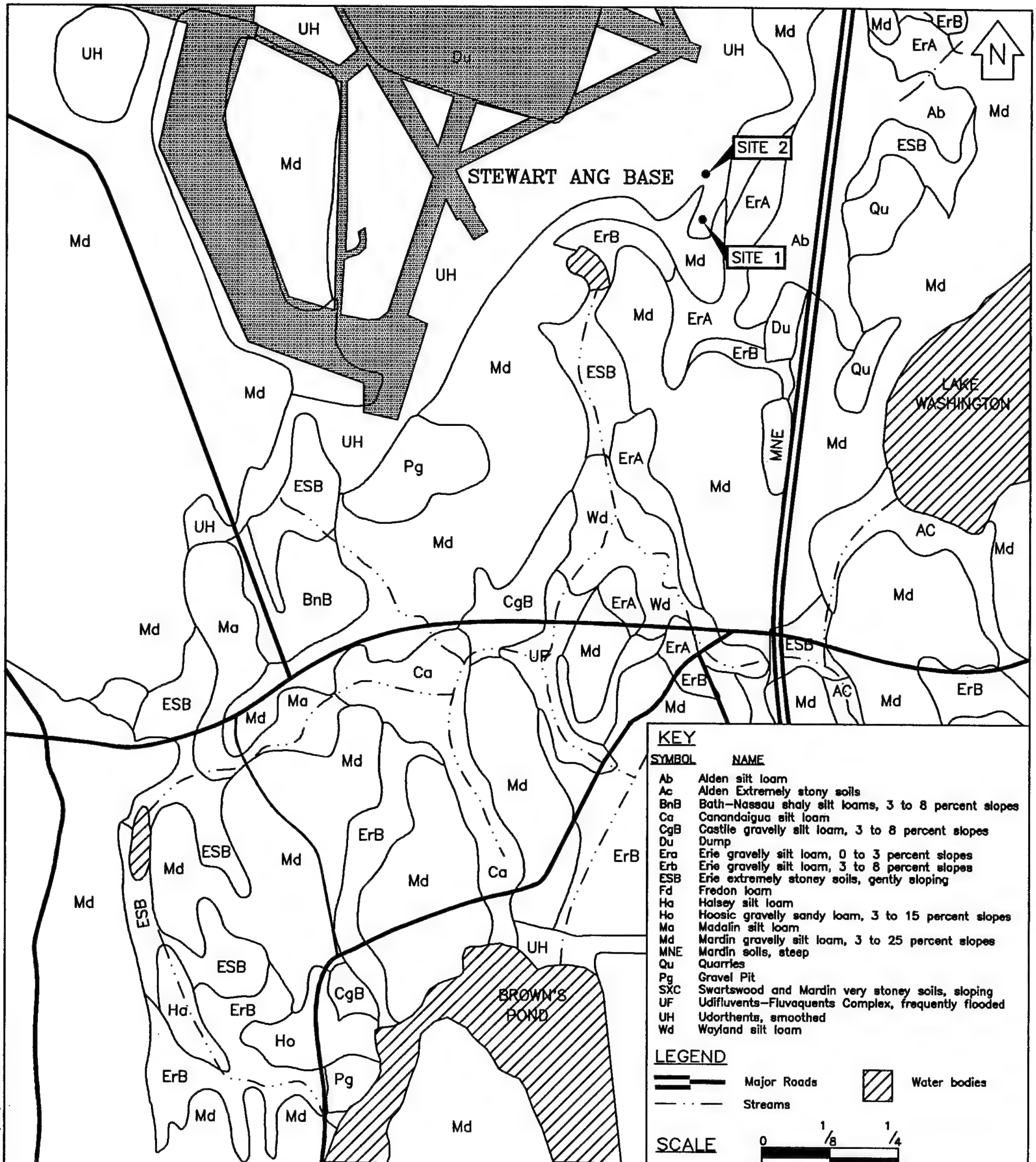
In this area, the till is often clay rich due to its origin (provenance) from shale bedrock parent material.

The primary landforms in this region are ground moraines and drumlins derived from advancing glaciers. Ground moraine consists of rolling, hilly terrain composed of lodgement till deposited on bedrock. Thicker deposits of till are found in the valleys than in the higher elevations because the thicker ice accumulation in the valleys remained active longer than the thinner ice at the higher elevations (Cadwell, 1989). The till thickness averages 20 feet but is dependent upon the bedrock irregularities (Frimpter, 1972). Drumlins are ice-molded, tear-drop or elliptically shaped hills that are aligned parallel to glacial flow with the blunt end oriented opposite the direction of glacier movement. They are thought to form as the ice sheet moves over resistant outcrops of bedrock, causing lodgement till to be "plastered" onto the resistant bedrock outcrop under very high pressure. Numerous drumlins are found in this region. The thickness of the till in the drumlins can vary from 75 to 200 feet (Frimpter, 1972).

The overburden at Site 1 consists primarily of grey to dark grey, very dense, poorly sorted glacial till, overlain by brown weathered till also referred to in the SI as "ablation till" (E.C. Jordan, 1989). The "ablation till" term is not considered correct because ablation till is material contained within a glacier that is deposited as ice melts. It is less dense than lodgement till and is often of different composition than the underlying lodgement till. The less dense till at this site is interpreted to be a product of the weathering of the underlying lodgement till and any site-specific reference to this stratum will be referred to herein as weathered till. The upper till unit tends to contain more sands in the vicinity of Site 1 (Dames and Moore, 1986). The SI also identified a thin, discontinuous layer of "slope wash" or lacustrine material at lower elevations that was not separately mapped. SI grain size analyses of 12 soil samples generally were described as "well-graded material with a fine fraction" (smaller than 200 sieve) of 27 to 55 percent and "a slight bimodal grain size distribution."

3.3 Soils

Soils at the site are mapped as "Udorthents, Smoothed" (Soil Conservation Service [SCS], 1975). This soil unit is assigned to any area that has been subject to activities such as regrading. Surrounding undisturbed soil units are mapped primarily as Mardin-Erie gravelly silt loams, which are described as upland glacial till deposits (Figure 3-5). These soils are categorized as gently sloping to sloping, deep, moderately well drained to somewhat poorly drained, medium textured soils (E.C. Jordan, 1989). Records indicate that the roads and runways on the Base were constructed using fill from local sources, which would be primarily the same class of soil (E.C. Jordan, 1989).



KEY

SYMBOL	NAME
Ab	Alden silt loam
Ac	Alden Extremely stony soils
BnB	Bath–Nassau shaly silt loams, 3 to 8 percent slopes
Ca	Canandaigua silt loam
CgB	Castile gravelly silt loam, 3 to 8 percent slopes
Du	Dump
Era	Erie gravelly silt loam, 0 to 3 percent slopes
Erb	Erie gravelly silt loam, 3 to 8 percent slopes
ESB	Erie extremely stoney soils, gently sloping
Fd	Fredon loam
Ha	Halsey silt loam
Ho	Hoosic gravelly sandy loam, 3 to 15 percent slopes
Ma	Madalin silt loam
Md	Mardin gravelly silt loam, 3 to 25 percent slopes
MNE	Mardin soils, steep
Qu	Quarries
Pg	Gravel Pit
SXC	Swartswood and Mardin very stoney soils, sloping
UF	Udifluvents–Fluvaquents Complex, frequently flooded
UH	Udorthents, smoothed
Wd	Wayland silt loam

LEGEND

Major Roads

Water bodies

Streams

SCALE 0 1/8 1/4

Scale in miles

PREPARED FOR
NATIONAL GUARD BUREAU

DATE
OCTOBER 31, 1996

SCALE
1:15840

SOURCE
USGS, 1975

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 W. Central Street, Natick, MA 01760

TITLE
FIGURE 3–5
SOIL MAP

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

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3.4 Surface Hydrology

The Base has few surface water features. Surface water runoff at the Base is controlled by a storm water drain system (Figure 3-6). Storm water over the majority of the Base flows via this storm water system into Recreation Pond south of the Base. In the vicinity of Site 1, storm water runoff is not captured by the drainage system. Stormwater runoff from the northwestern portion of the landfill flows overland to a drainage swale on the western side of the crushed stone Patrol Road and then north to a culvert running under the road. Discharge from the culvert continues to flow eastward eventually entering a wetland area which is drained by Murphy's Gulch, located east of Site 1.

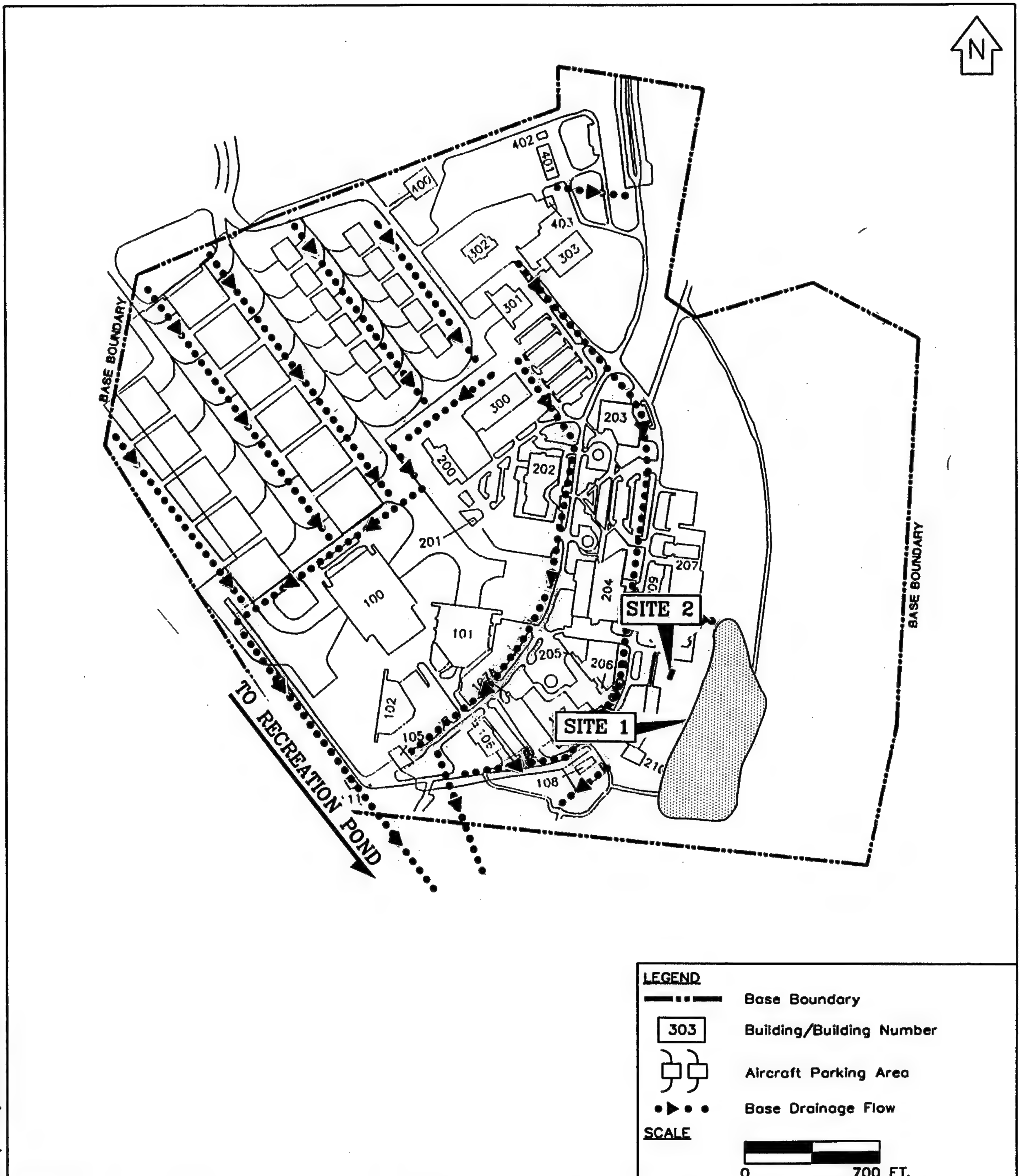
From the southwestern portion of the landfill, stormwater runoff flows via a channel which runs along the southern boundary of the fill material. Based on visual observations, this channel was either excavated for storm water drainage or has been severely eroded over time. This channel terminates at the toe of the steep side slope. Discharge from this channel then continues to flow overland until eventually entering the wetland area drained by Murphy's Gulch. Stormwater runoff originating from the steep side slope of the landfill flows eastward as overland flow, entering small local channels, and eventually entering the wetland area drained by Murphy's Gulch.

The area surrounding Site 1 to the west has only been developed since approximately 1987. Prior to this development the crushed rock Patrol Road did not exist, and storm water runoff was allowed to flow over the side slope. This runoff flowed to the pond area north of Site 1, with the overflow eventually reaching Murphy's Gulch.

Murphy's Gulch also receives runoff from the New Windsor Landfill. After entering Murphy's Gulch surface water flows north and east under Route 87. This water then flows through Murphy's Gate, a diversion structure which formerly diverted water into Lake Washington. This gate has been closed due to the potential for the introduction of contamination into Lake Washington, the source of which has not yet been determined. This surface water eventually flows into Brookside Pond and Quassaic Creek. Quassaic Creek discharges into the Hudson River. Drainage patterns for the area downgradient of Site 1 are illustrated in Figure 3-7.

3.5 Regional/Local Hydrogeology

Regional groundwater flow in the vicinity of Site 1 is southeast towards the Hudson River, based on the elevations of surface water bodies located near the Base. Groundwater movement occurs primarily in the weathered till, the underlying lodgement till to a lesser extent, and in the underlying bedrock. However, the Normanskill Formation and underlying bedrock tend to have low permeabilities, and are poor sources of groundwater (E.C. Jordan, 1989). A well drilled to a depth of more than 1,000 feet in 1987 yielded less than 10 gallons per minute (gpm). Groundwater flow in the bedrock is primarily controlled by joints, fractures and bedding planes (Frimpter, 1972).



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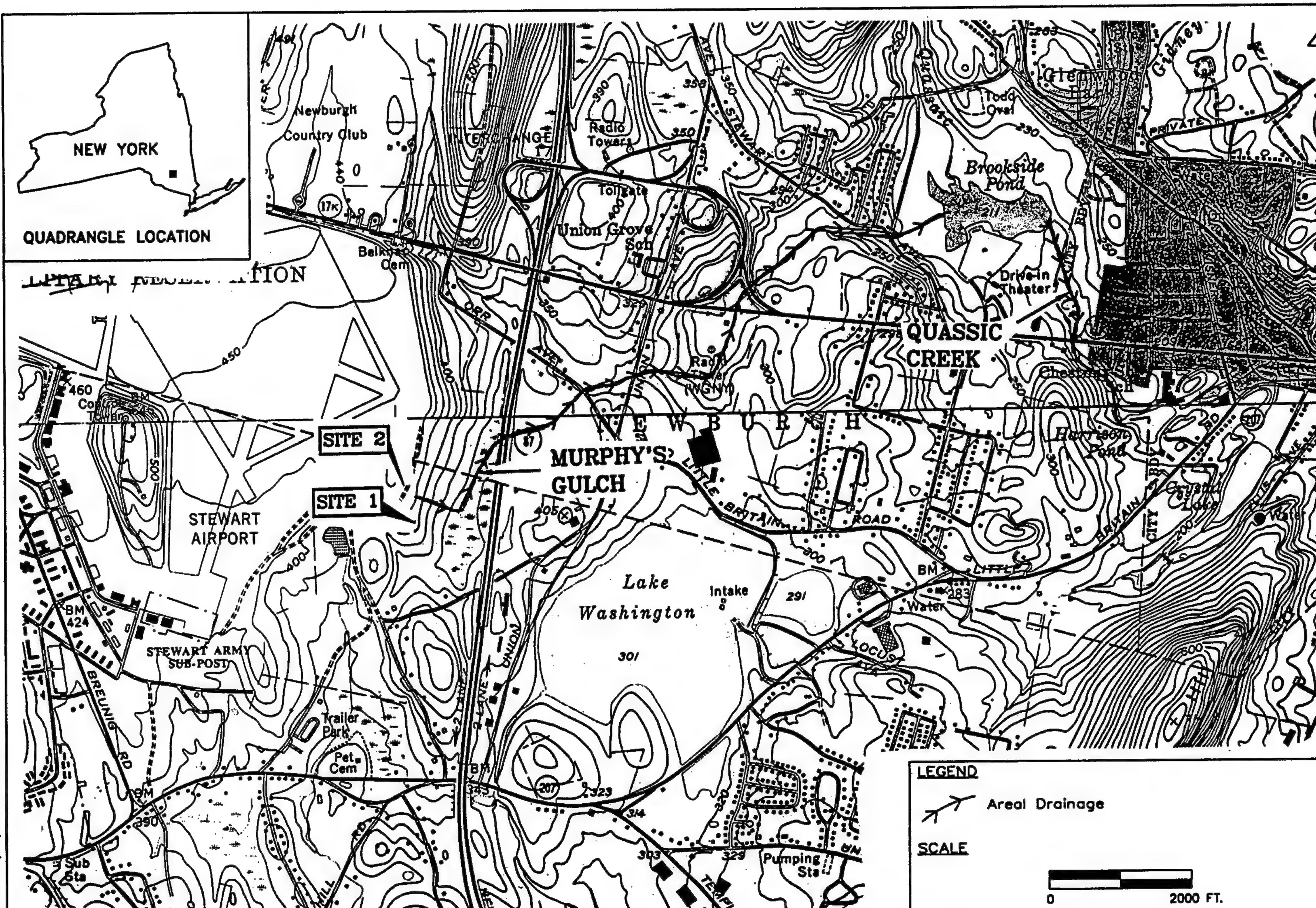
PREPARED FOR			TITLE
NATIONAL GUARD BUREAU		ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 W. Central Street, Natick, MA 01760	FIGURE 3-6 BASE STORMWATER DRAINAGE MAP
DATE APRIL 22, 1997	SCALE 1 IN. = 700 FT.		STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK
SOURCE 105th AIRLIFT GROUP, STEWART INTERNATIONAL AIRPORT, BASE MAP, 1993			



LEGEND

Areal Drainage

SCALE

0 2000 FT.

PREPARED FOR NATIONAL GUARD BUREAU		ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 W. Central Street, Natick, MA 01760	TITLE FIGURE 3–7 AREAL DRAINAGE MAP STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK
DATE OCTOBER 31, 1996	SCALE 1 IN. = 2000 FT.		
SOURCE USGS, 1957; USGS, 1981			

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Groundwater was encountered at a depths varying from approximately 30 to 5 feet below grade, in the vicinity of Site 1 (E.C. Jordan, 1989). The groundwater was believed to be perched on top of the bedrock. In addition, during the drilling of monitoring wells SW-01, SW-02 and SW-03 for the Site 2 hydrogeologic investigation, abundant groundwater was encountered under pressure in the weathered bedrock zone (Dames and Moore, 1986).

Based on potentiometric data obtained from the monitoring wells and multi-level piezometers installed as part of the SI, groundwater flow in the till and fractured shale was interpreted to be eastward, towards the toe of the former landfill. The horizontal hydraulic gradient in the area of Site 1 (i.e., between JTB-101B and JTB-108B) was calculated to be 0.07 feet per foot (ft/ft). SI groundwater contours for Site 1 area are illustrated in Figure 3-8. Monitoring well construction details for wells located in the vicinity of Site 1 are provided in Section 5. SI monitoring well construction diagrams are provided in Appendix A, Basewide Site Inspection Data.

Vertical gradients were downward at all locations except at multi-level piezometers JTB-108 and JTB-110. Downward hydraulic gradients in the bedrock were calculated to range from 0.005 to 0.239 ft/ft. Downward gradients in the till were calculated to range from 0.515 to 0.878 ft/ft. Upward gradients were found to range from 0.01 to 0.03 ft/ft. The fact that downward gradients were encountered on the up-slope side of the landfill and upward gradients were encountered closer to Murphy's Gulch suggests that groundwater from the vicinity of Site 1 is likely discharging into Murphy's Gulch.

During the Site 2 hydrogeologic investigation performed by Dames & Moore, estimates of the hydraulic conductivity of the weathered fractured shale bedrock layer were made by performing in-situ variable head recovery slug tests on monitoring wells SW-01, SW-02 and SW-03. The average estimate for the three wells using the Hvorslev lag-time method is 5.6×10^{-5} centimeters per second (cm/sec) (Dames and Moore, 1986). Rising-head slug tests were also performed by E.C. Jordan on the four monitoring wells installed as part of the SI. None of these wells were screened across the groundwater table. Based on this testing the average hydraulic conductivity of the lodgement till was found to be 4.19×10^{-5} cm/sec (E.C. Jordan, 1989). One test performed within the weathered till yielded a hydraulic conductivity of 4.20×10^{-5} cm/sec.

3.6 Groundwater Usage

Groundwater usage in the vicinity of the Base appears to be limited to areas in which town water is not being supplied, where it was assumed that groundwater is used as the potable water supply. These areas include:

- Route 17K, west of the Throughway to East Coldenham.
- Orr Avenue, west of Union Avenue.
- Liner Avenue, west of Union Avenue and east of the Thruway.
- Silver Stream and Liner Roads, from Route 207 to the Thruway.
- All residences and businesses south of Route 207 in New Windsor.

ANEPTEK interviewed the Town of New Windsor Water Supply Engineer and the Town of Newburgh Tax Receiver and Building Inspector to determine where groundwater is used in the vicinity of the Base and to verify/update the information presented in the SI Report. The interviewed officials indicated that there still is no service along any part of Orr Avenue. Water mains have been installed along Route 17K, however, not every home or facility is hooked-up. This information indicates continued use of private wells for potable water. Also, not all homes and/or facilities located in areas in which town water is available are connected to the town water supply. Water distribution lines, lots served by known water wells, and areas supplied by individual water supply wells are shown on Figure 3-9. According to the Newburgh Building Inspector, municipalities do not keep records on individual wells, therefore it is impossible to determine in which formation individual wells are completed or exactly where they are located.

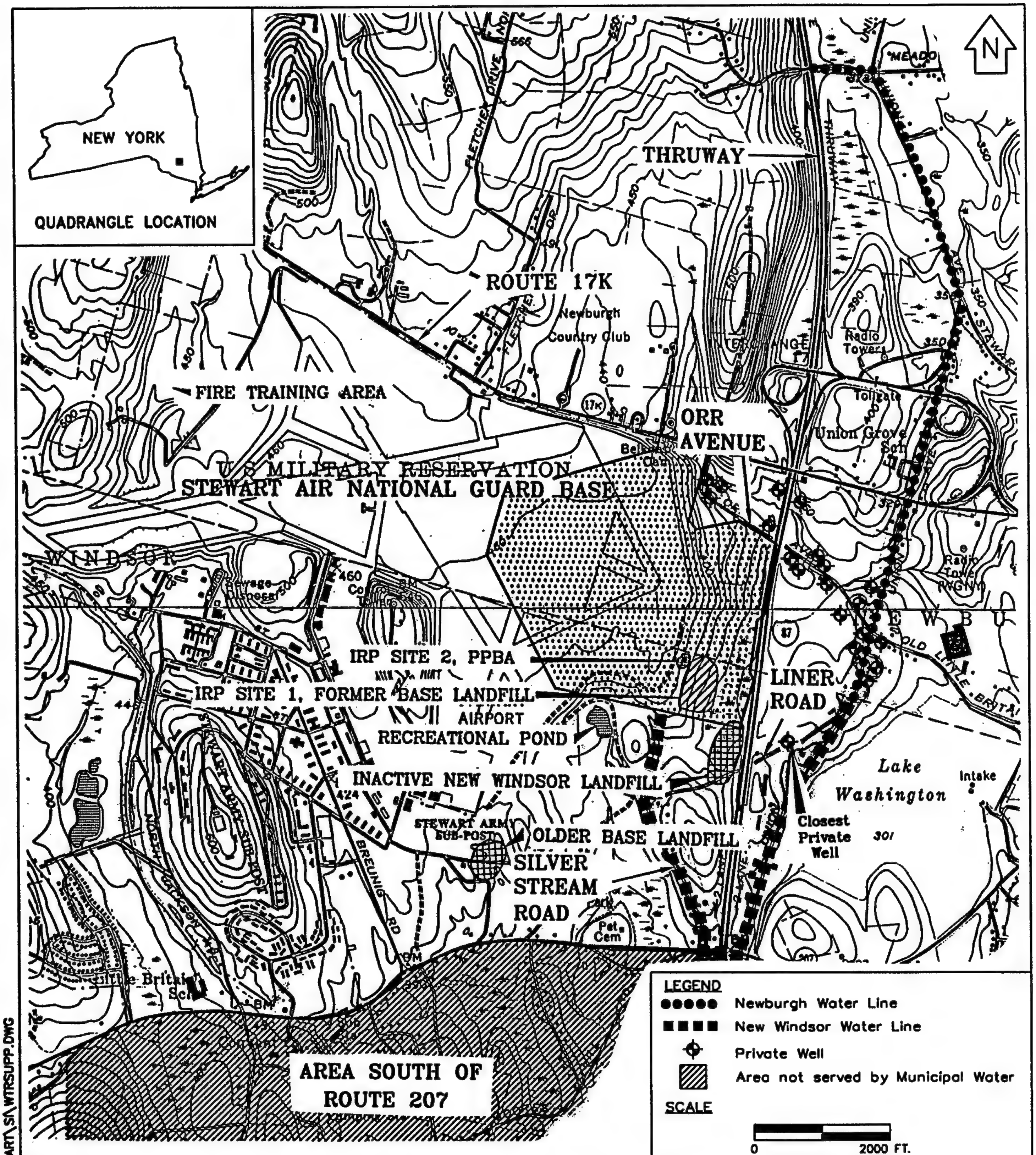
3.7 Climate

Most of the climatic data for the Base were obtained from stations located at West Point, New York (SCS, 1975) and the Stewart Air Force Base (National Climatic Data Center [NCDC], 1995). The climate in the area is categorized as humid continental. The average daily temperature is 51.6°Fahrenheit (F), with cold winters and moderately warm summers. The lowest average daily minimum temperature, 19.2°F, occurs in January, and the highest average daily maximum temperature, 86.3°F occurs in July. The average wind speed is 8 knots, with a predominant westerly wind direction. The highest wind speed recorded at the Base was 84 knots, which occurred in June.

The average annual rainfall is 48.01 inches. The rainiest month is May, with an average rainfall of 3.94 inches. Typically, there are 8 to 11 days of measurable rainfall each month. The average annual net precipitation is 14 inches (precipitation minus (-) evapotranspiration). February and March are the snowiest months, with average snowfalls of 11.4 and 10.1 inches, respectively.

3.8 Ecology

No threatened or endangered habitats are located in the vicinity of Site 1 or within a two-mile radius. A wetland area is located to the east of Site 1, however, this area is not identified as a NYSDEC-regulated wetland. Six NYSDEC-regulated wetlands are located within a two-mile radius. Only one of these wetland areas is located within the downstream pathway from the site. Area NB-29 is located approximately 7,000 feet downstream of Site 1.



PREPARED FOR		
NATIONAL GUARD BUREAU		
DATE: APRIL 22, 1997	SCALE: 1 IN. = 2000 FT.	
SOURCE: TOWNS OF NEWBURGH AND NEW WINDSOR, NY		

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 W. Central Street, Natick, MA 01760

TITLE
FIGURE 3-9
MUNICIPAL WATER SUPPLY DISTRIBUTION

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

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SECTION 4.0

4.0 FIELD PROGRAM

This section presents a general discussion of the field program implemented as part of the Site 1 CI. Section 4.1 presents a summary of the overall approach to the CI field program. Deviations from the approved CI work plan (ANEPTEK, 1995b) are listed in Section 4.2. Sections 4.3, 4.4, and 4.5 present general descriptions of the on-site screening and sampling and analysis performed during the field program at Site 1.

4.1 Summary

The field program was implemented in accordance with the CI work plan (ANEPTEK, 1995b), except as noted in Section 4.2, Deviations from the Work Plan. The planned and executed field programs are summarized on Table 4-1. A summary of sampling intervals and associated analyses is presented on Table 4-2. A listing of the analytical methods used for each analysis performed is presented in Table 4-3. The initial mobilization for the field program took place on June 13, 14, and 15, 1995. The second mobilization started on September 7, 1995 and ended December 6, 1995. The third mobilization occurred from July 22, 1996 through August 15, 1996.

4.1.1 Objectives

The field program was designed to achieve the following objectives:

- Obtain current groundwater flow data.
- Define current groundwater quality in both the shallow and deeper portions of the aquifer downgradient of the landfill.
- Define current surface water quality within the stream known as Murphy's Gulch.
- Determine the potential for explosive gas generation and migration within and immediately around the fill material.
- Determine settlement characteristics and slope stability of the fill material to support engineering analyses and ensure an appropriate cover system design.

4.1.2 Approach

The field program included checking for explosive gas around and over the landfill, installing and monitoring slope stability monuments, construction and monitoring of settlement pads, excavation of test pits, and the installation of groundwater monitoring wells and the collection of groundwater and surface water samples for chemical analysis. All groundwater and surface

TABLE 4 - 1
PLANNED AND EXECUTED FIELD PROGRAM SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

	PLANNED FIELD PROGRAM			EXECUTED FIELD PROGRAM		
FIELD ACTIVITY	NO. OF SAMPLES/TEST LOCATIONS	ANALYSES	RATIONALE	NO. OF SAMPLES/TEST LOCATIONS	ANALYSES	RATIONALE
Explosive Gas Investigation	NS	On-site Screening with FID and 4-Gas Meter	Perform 3 rounds of measurements at maximum intervals of 100 ft around perimeter of fill material, and at several locations over fill, advance holes using a "slam bar" and monitor opening of hole for explosive gasses.	Varied for each Round	On-site Screening with FID and 4-Gas Meter	Three rounds of measurements were performed in accordance with the work plan.
Slope Stability Monitoring	12	Surveyed for Horizontal Location	Install 12 slope stability monuments, made of 4-inch diameter steel pipe, over the steep side slope of the fill material. Survey monuments 3 times over a year's time to monitor lateral movement.	7	Surveyed for Horizontal Location	Due to difficulty installing monuments in tight soils and fill material, only 7 monuments were able to be installed. These monuments were surveyed three times from July 1995 through July 1996.
Landfill Settlement Monitoring	3	Surveyed for Vertical and Horizontal Location	Construct three concrete pads with survey markers near the top break of the steep side slope. Load pads with concrete blocks providing a dead load approximately twice that of a typical landfill cover. Survey pads over time to monitor settlement.	3	Surveyed for Vertical and Horizontal Location	Three settlement pads were installed and surveyed in accordance with the work plan.
Test Pit Program	NS	NA	Excavate a series of test pits around the periphery of the fill material to determine lateral extent of the landfill. Start excavation outside of fill material, stop excavation and mark location when waste encountered.	35	NA	All test pits were excavated in accordance with the work plan.
Monitoring Well Installation	9	NA	Advance soil borings to install 3 upgradient and 6 downgradient groundwater monitoring wells, soil borings to be sampled continously for soil logging purposes. To be used to fully define hydrologic characteristics and groundwater quality at the site in conjunction with other nearby monitoring wells.	9	NA	Two of the upgradient wells were not installed due to the absence of saturated overburden. Two additional wells were installed to the south of the landfill to provide full downgradient coverage of groundwater quality.

TABLE 4 - 1 (cont.)
PLANNED AND EXECUTED FIELD PROGRAM SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

	PLANNED FIELD PROGRAM			EXECUTED FIELD PROGRAM		
FIELD ACTIVITY	NO. OF SAMPLES/TEST LOCATIONS	ANALYSES	RATIONALE	NO. OF SAMPLES/TEST LOCATIONS	ANALYSES	RATIONALE
Groundwater Sampling	12	Baseline Parameters[1]	Collect groundwater samples from 12 monitoring wells, including 3 installed as part of other IRP activities at the Base. Samples to be collected from 4 upgradient wells and 8 downgradient wells. Submit samples for analysis to determine groundwater quality.	12	Baseline Parameters[1]	Two of the upgradient samples were not collected due to the absence of saturated overburden. Two additional samples collected from additional well pair installed to the south of the landfill.
Staff Gage Installation	3	Surface Water Elevations	Install 3 staff gages within Murphy's Gulch, 1 upstream of the landfill, 1 downstream, and a third located across from the landfill. In conjunction with groundwater elevations from monitoring wells, surface water elevations to be used to define hydrologic characteristics.	6	Surface Water Elevations	To provide additional data points, 2 gages were installed in Murphy's Gulch, 2 were installed in a nearby man-made drainage swale, 1 was installed in a small settling pond along Murphy's Gulch, and 1 was installed in the ponded area adjacent to the landfill.
Surface Water Sampling	3	Baseline Parameters[1]	Collect samples from 1 upstream location, 1 downstream location, and 1 location across from the landfill. Submit samples for analysis to determine surface water quality.	3	Baseline Parameters[1]	All surface water samples collected and analyzed in accordance with the work plan.
Leachate Investigation	3	Baseline Parameters[1]	Perform visual inspection of the landfill for leachate breakouts. Any leachate encountered to be sampled and analyzed to define the chemical characteristics of the leachate.	None	None	No leachate breakouts were encountered during the visual inspection. Therefore, no samples were collected.

TABLE 4 - 1 (cont.)
PLANNED AND EXECUTED FIELD PROGRAM SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

	PLANNED FIELD PROGRAM			EXECUTED FIELD PROGRAM		
FIELD ACTIVITY	NO. OF SAMPLES/TEST LOCATIONS	ANALYSES	RATIONALE	NO. OF SAMPLES/TEST LOCATIONS	ANALYSES	RATIONALE
Vector Survey/ Wetland Delineation	NA	NA	A qualified field biologist to walk the entire landfill, looking for evidence of rodents and burrowing animals. To evaluate potential for landfill to impact nearby wetlands, field biologist to determine wetland boundary.	NA	NA	The vector survey was performed in accordance with 6 NYCRR Part 360-2.15. Wetland delineation performed in accordance with U.S. Army Corps of Engineers Manual.
Surveying	NA	NA	All monitoring wells, staff gages, test pits, and site topography to be surveyed by a New York licensed surveyor.	NA	NA	Surveying performed by a New York licensed surveyor.
Hydrogeologic Testing	9	In situ Permeability (Slug) Testing	Perform slug tests on newly installed groundwater monitoring wells to estimate local hydraulic conductivity.	7	In situ Permeability (Slug) Testing	Slug tests were performed on all newly installed groundwater monitoring wells except MW-14 and MW-15. Two of the proposed wells were not installed due to the absence of saturated overburden.
Grain Size Distribution/ Cover Soil Permeability Evaluation	NP	NP	No samples were proposed to be collected for grain size distribution evaluation in the work plan.	4	Sieve and Hydrometer Testing	To estimate the permeability of soils which comprise the existing interim cover soil samples were collected and submitted for grain size distribution testing.

ABBREVIATIONS
FID - Flame Ionization Detector
NA - Not Applicable
NP - Not Planned
NS - Not Specified
NYCRR - New York Code of Rules and Regulations

NOTES
1. Baseline Parameters as specified in 6 NYCRR Part 360-2.11.

TABLE 4-2
LABORATORY ANALYTICAL PROGRAM SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE DESIGNATION[1]	FIELD PARAMETERS[2]	LEACHATE INDICATORS[2]	INORGANIC PARAMETERS[2]	ORGANIC PARAMETERS[2]	NOTES
Surface Water					
SW-01-120195	•	•	•	•	
SW-11-120195	•	•	•	•	Duplicate of sample SW-01-120195
SW-02-120195	•	•	•	•	Background
SW-03-120195	•	•	•	•	
Groundwater					
MW-01-112995	•	•	•	•	Background
MW-04-120195	•	•	•	•	Background
MW-05-113095	•	•	•	•	
MW-15-113095	•	•	•	•	Duplicate of sample MW-05-113095
MW-06-113095	•	•	•	•	
MW-07-113095	•	•	•	•	
MW-08-113095	•	•	•	•	
MW-09-112995	•	•	•	•	
MW-10-112995	•	•	•	•	
MW-11-113095	•	•	•	•	
MW-12-113095	•	•	•	•	
MW-14-081496	•	•	•	•	
MW-15-081496	•	•	•	•	
MW-25-081496	•	•	•	•	Duplicate of MW-15-081496

ABBREVIATIONS

NYCRR - New York Code of Rules and Regulations

NOTES

1. The last six digits of the sample designations identifies the date of sample collection by month, day, and year, respectively.
2. Each set of analytical parameters as required in 6 NYCRR Part 360-2.11.

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TABLE 4-3
SUMMARY OF ANALYTICAL METHODS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETER	METHOD	REFERENCE
LEACHATE INDICATORS		
Total Kjeldahl Nitrogen	SM174500 NH3E	1
Ammonia	SM174500 NH3 H	1
Nitrate-Nitrite	SM174500 NO3 F	1
Chemical Oxygen Demand	EPA 410.2	2
Biochemical Oxygen Demand	EPA 405.1	2
Total Organic Carbon	EPA 415.2	2
Total Dissolved Solids	EPA 160.1	2
Sulfate	EPA 375.4	2
Alkalinity	SM172320-B	1
Phenols	EPA 420.1	2
Chloride	SM174500-CLB	1
Bromide	EPA 300	2
Total Hardness as $CaCO_3$	EPA 200.7	2
Color	EPA 110.2	2
INORGANIC PARAMETERS		
Aluminum	EPA 200.7	2
Antimony	EPA 200.7	2
Arsenic	EPA 206.2	2, 3
Barium	EPA 200.7	2
Beryllium	EPA 200.7	2
Boron	EPA 200.7	2
Cadmium	EPA 200.7	2
Calcium	EPA 200.7	2
Chromium	EPA 200.7	2
Cobalt	EPA 200.7	2
Copper	EPA 200.7	2
Cyanide, Total	EPA 335.2	2
Hexavalent Chromium	SM183500 Cr-D	4
Iron	EPA 200.7	2
Lead	EPA 239.2	2, 3
Magnesium	EPA 200.7	2
Managnese	EPA 200.7	2
Mercury	EPA 245.1	2
Nickel	EPA 200.7	2
Potassium	EPA 200.7	2
Selenium	EPA 270.2	2,3
Silver	EPA 200.7	2
Sodium	EPA 200.7	2
Thallium	EPA 279.2	2, 3
Vanadium	EPA 200.7	2
Zinc	EPA 200.7	2
ORGANIC PARAMETERS		
Chloromethane	EPA 624	5
Bromomethane	EPA 624	5
Vinyl chloride	EPA 624	5
Chloroethane	EPA 624	5
Methylene chloride	EPA 624	5
Acetone	EPA 624	5
Carbon disulfide	EPA 624	5
1,1-Dichloroethene	EPA 624	5
1,1-Dichloroethane	EPA 624	5

TABLE 4-3 (cont.)
SUMMARY OF ANALYTICAL METHODS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETER	METHOD	REFERENCE
ORGANIC PARAMETERS		
1,2-Dichloroethene (total)	EPA 624	5
Chloroform	EPA 624	5
1,2-Dichloroethane	EPA 624	5
2-Butanone	EPA 624	5
1,1,1-Trichloroethane	EPA 624	5
Carbon tetrachloride	EPA 624	5
Vinyl acetate	EPA 624	5
Bromodichloromethane	EPA 624	5
1,2-Dichloropropane	EPA 624	5
cis-1,3-Dichloropropene	EPA 624	5
Trichloroethene	EPA 624	5
Benzene	EPA 624	5
Dibromochloromethane	EPA 624	5
trans-1,3-Dichloropropene	EPA 624	5
1,1,2-Trichloroethane	EPA 624	5
Bromoform	EPA 624	5
4-Methyl-2-pentanone	EPA 624	5
2-Hexanone	EPA 624	5
1,1,2,2-Tetrachloroethane	EPA 624	5
Tetrachloroethene	EPA 624	5
Toluene	EPA 624	5
Chlorobenzene	EPA 624	5
Ethylbenzene	EPA 624	5
Styrene	EPA 624	5
Xylenes, Total	EPA 624	5
1,2-Dichlorobenzene	EPA 624	5
1,3-Dichlorobenzene	EPA 624	5
1,4-Dichlorobenzene	EPA 624	5
1,1,1,2-Tetrachloroethane	EPA 624	5
1,2,3-Trichloropropane	EPA 624	5
Trichlorofluoromethane	EPA 624	5
Acrylonitrile	EPA 624	5
Bromochloromethane	EPA 624	5
1,2-Dibromomethane	EPA 624	5
1,2-Dibromo-3-chloropropane	EPA 624	5
Dibromomethane	EPA 624	5
trans-1,4-dichloro-2-butene	EPA 624	5
Iodomethane	EPA 624	5
GEOTECHNICAL PARAMETERS		
Particle Size Distribution	ASTM D 422	6

REFERENCE

1) "Standard Methods for the Examination of Water and Wastewater", 17th Edition, 1989.
2) "Methods for Chemical Analysis of Water and Wastewater", EPA-600/4-79-020, March 1983.
3) Atomic Absorption - Furnace Technique.
4) "Standard Methods for the Examination of Water and Wastewater", 18th Edition, 1992.
5) Federal Register, V. 50 No. 3, January 4, 1985.
6) "Book of ASTM Standards" 1995.

water samples were submitted to an off site laboratory for the full list of Baseline Parameters as specified in 6 NYCRR Part 360-2.11 and listed in Table 4-3.

All off-site laboratory analyses were performed by EnviroTest Laboratories, a New York State certified laboratory. Analyses were performed in accordance with their respective analytical methods as listed in Table 4-3.

4.2 Deviations from the Work Plan

The following is a summary of deviations from the work plan. Field change request forms are presented in Appendix B.

- Two-inch inside diameter (ID) groundwater monitoring wells were installed, instead of 4-inch ID wells as proposed in the work plan. Drilling the borehole for a 4-inch well was not practical due to the tightness of the subsurface material. The reduction of the well diameter did not affect the overall quality of the program.

- The two upgradient, overburden groundwater monitoring wells were not installed due to the absence of groundwater in the overburden to the west of the landfill. This change also did not affect the overall quality of the program.

- Well development procedures were altered such that only a volume of water equivalent to the volume of water lost during drilling was removed, instead of three times that volume. This change was required due to the relatively slow recharge of most of the wells. This change did not affect the overall quality of the program, as based on visual observations, the only water lost during drilling was lost at the ground surface.

- An additional groundwater monitoring well pair was installed to the south of the landfill. This change was necessary, due to an apparent radial component of groundwater flow direction beneath the southwestern portion of the landfill. This addition of a well pair increased the overall quality of the field program as groundwater quality to the south of the landfill would not have been defined without this well pair.

4.3 Field Investigation Activities

This section presents general descriptions for each of the field activities performed as part of the CI. Results of each of these activities are presented in Section 5.0 of this report.

4.3.1 Explosive Gas Investigation

In accordance with 6 NYCRR Part 360-2.15(a)(2) an explosive gas survey was performed at Site 1. Initially, this investigation was to include the installation of three landfill gas monitoring wells to the west of the landfill to determine if subsurface migration of explosive gas to the west of the landfill could potentially pose safety risks (ANEPTEK, 1995a). Groundwater was

anticipated to be present at a depth of approximately 25 to 30 feet bgs, based on available information and the measurement of the depth to groundwater in a nearby existing monitoring well. During advancement of the landfill gas monitoring well soil borings, groundwater was initially encountered at a depth of 10.5 feet bgs in the first soil boring. During advancement of the second soil boring, the hollow stem auger was unable to advance deeper than 16 feet bgs. Both of these boreholes were allowed to remain open, with augers in place and covered. The next morning water had risen to a depth of 6.5 feet bgs in the first soil boring and 10.5 feet bgs in the second boring.

Due to these findings, it was concluded that the permeability of the subsurface materials is low enough to restrict significant subsurface gas migration west of the landfill. The presence of vadose zone moisture in the soils indicates that the subsurface soils drain slowly after precipitation events. The long-term presence of moisture would increase the resistance to significant subsurface gas migration to the west of the landfill. Based on these observations, it would be anticipated that explosive gas, if present, will migrate vertically upward through the fill material or along the fill material/native material interface.

During a subsequent conversation with representatives from NYSDEC, it was agreed that the installation of the proposed landfill gas wells would not be required. As agreed to with NYSDEC, the explosive gas investigation was performed using a "slam bar" around the perimeter and over the fill material. The "slam bar" was used to advance holes approximately 2 to 4 feet deep. Once the "slam bar" was removed from each hole, the air at the opening of the hole was monitored using a Foxboro® 108 Organic Vapor Analyzer (OVA) flame ionization detector (FID) and a Bacharach® Sentinnel 44, 4-gas meter. The Bacharach® 4-gas meter is capable of detecting the percent oxygen and percent lower explosive limit (LEL) of the atmosphere, and the presence of carbon monoxide and hydrogen sulfide gas.

As required in 6 NYCRR Part 360-2.15(a)(2) and in accordance with the work plan (ANEPTEK, 1995b), measurements were taken at maximum intervals of 100 feet around the perimeter of the fill material. Readings were also taken using the "slam bar" method over the fill material itself to evaluate the potential for significant gas migration upwards through the fill material. All nearby storm drains, culverts, groundwater monitoring wells, and piezometers were also monitored for the presence of explosive gas using the FID and the 4-gas meter.

4.3.2 Leachate Investigation

In accordance with 6 NYCRR Part 360-2.15(a)(3) a surface leachate investigation was performed of the surface and around the fill material on June 13, 1995. The leachate investigation performed included a complete visual reconnaissance of the entire landfill surface and the area between the toe of the landfill and the nearby Murphy's Gulch to the east. Any leachate outbreaks were to be sampled for chemical analysis.

4.3.3 Test Pit Excavation

In order to confirm the lateral extent of fill material determined during the SI magnetometer survey, a series of test pits were excavated around the landfill perimeter. All test pits were excavated in accordance with the procedures outlined in Standard Operating Procedure (SOP) No. 3 in Appendix C of the work plan (ANEPTEK, 1995b). During excavation, field observations were recorded on the appropriate test pit logs.

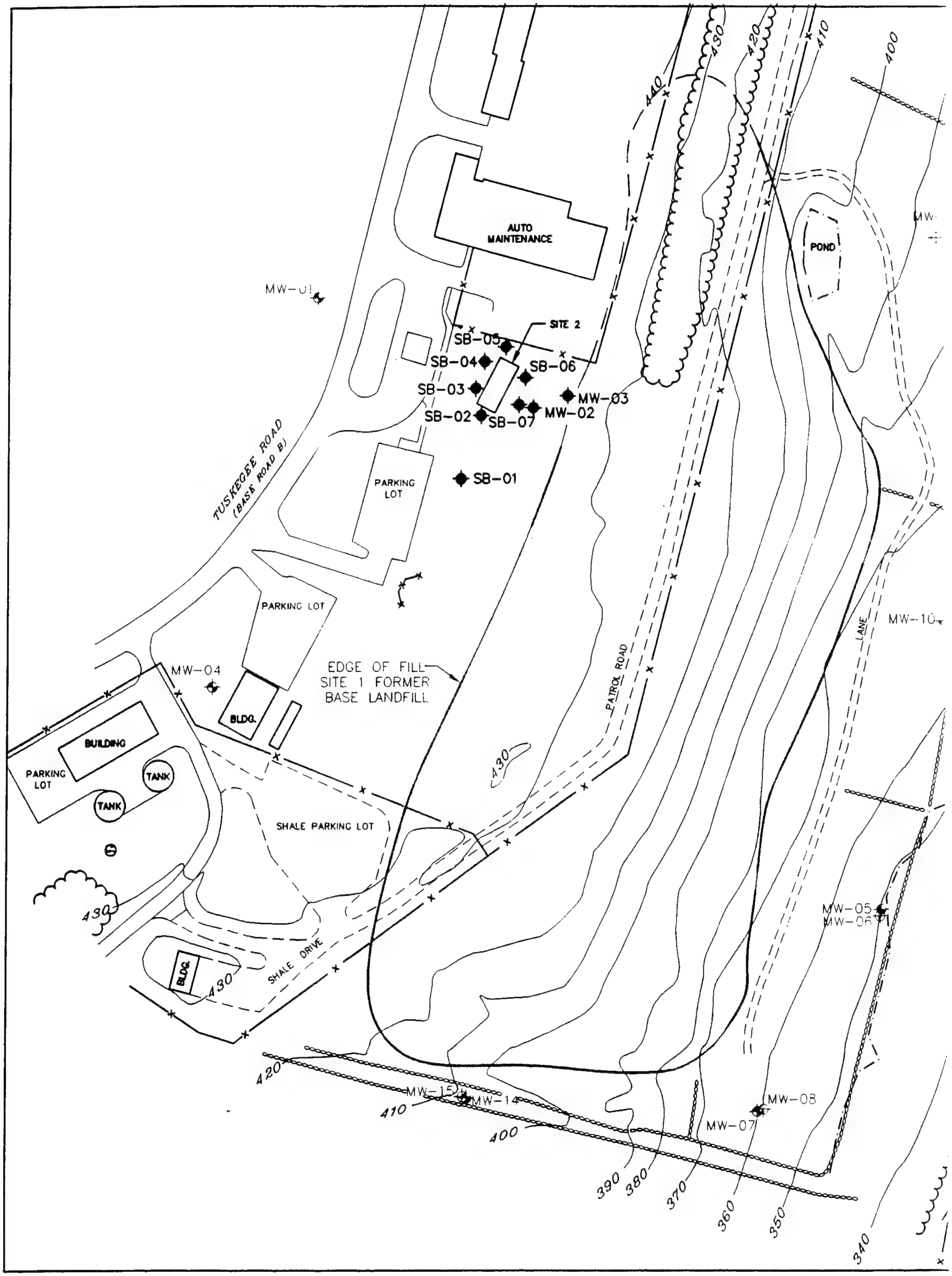
4.3.4 Soil Borings

Soil borings were advanced during the CI to collect subsurface soil samples, define site geology, and to install the groundwater monitoring wells. Soil borings were advanced using a CME-75 track-mounted drill rig by two methods: (1) hollow-stem augering in accordance with American Society for Testing and Materials (ASTM) Method D1452, and (2) drilling and core barrel sampling in accordance with ASTM Method D2113, followed by advancing steel casing. Soil boring locations are presented in Figure 4-1. Soil borings advanced as part of other IRP activities are included in Figure 4-1. Data obtained from these additional soil borings were used in conjunction with data obtained from soil borings advanced for the Site 1 CI to fully define the hydrogeologic conditions at the site. All soil borings were performed by East Coast-Thomas Drilling Company.

At each location, soil borings were initially advanced using 8.25-inch outside diameter (OD) hollow stem augers in accordance with SOP No. 2 in Appendix C of the work plan (ANEPTEK, 1995b), until split-spoon refusal occurred and the hollow stem auger could no longer be advanced. Drilling and soil sample collection were then performed with a 5-foot long diamond-bit NX-type core barrel sampler. This method was also used to collect bedrock cores in those borings that were advanced into bedrock. After an interval of soil was cored, steel casing were advanced into the borehole to case off the soils. For the Site 1 CI, soil borings were advanced only at the proposed monitoring well locations. At the location of each monitoring well pair, the deeper, bedrock well was drilled first, with soils and rock being logged continuously to the bottom of the borehole. Soils were not logged during advancement of the soil borings for the installation of the adjacent shallow wells, as agreed to with NYSDEC.

4.3.5 Monitoring Well Installation and Development

Monitoring wells were installed for the collection of groundwater samples, definition of groundwater flow characteristics, and the determination of aquifer properties. Monitoring wells were installed in boreholes advanced as described in Section 4.3.4. All wells were constructed of 2-inch ID Schedule 40 polyvinyl chloride (PVC) with 0.10-slot wire-wrap screen covered with a filter sock. Figure 4-1 presents the locations of each monitoring well. Monitoring wells MW-01, MW-04, MW-05, MW-07, MW-09, MW-11, and MW-14 were screened in shallow bedrock. Monitoring wells MW-06, MW-08, MW-10, MW-12, and MW-15 were screened within the overburden. Monitoring wells MW-01 and MW-04 were installed in areas which are not downgradient of the landfill and groundwater within these wells is therefore



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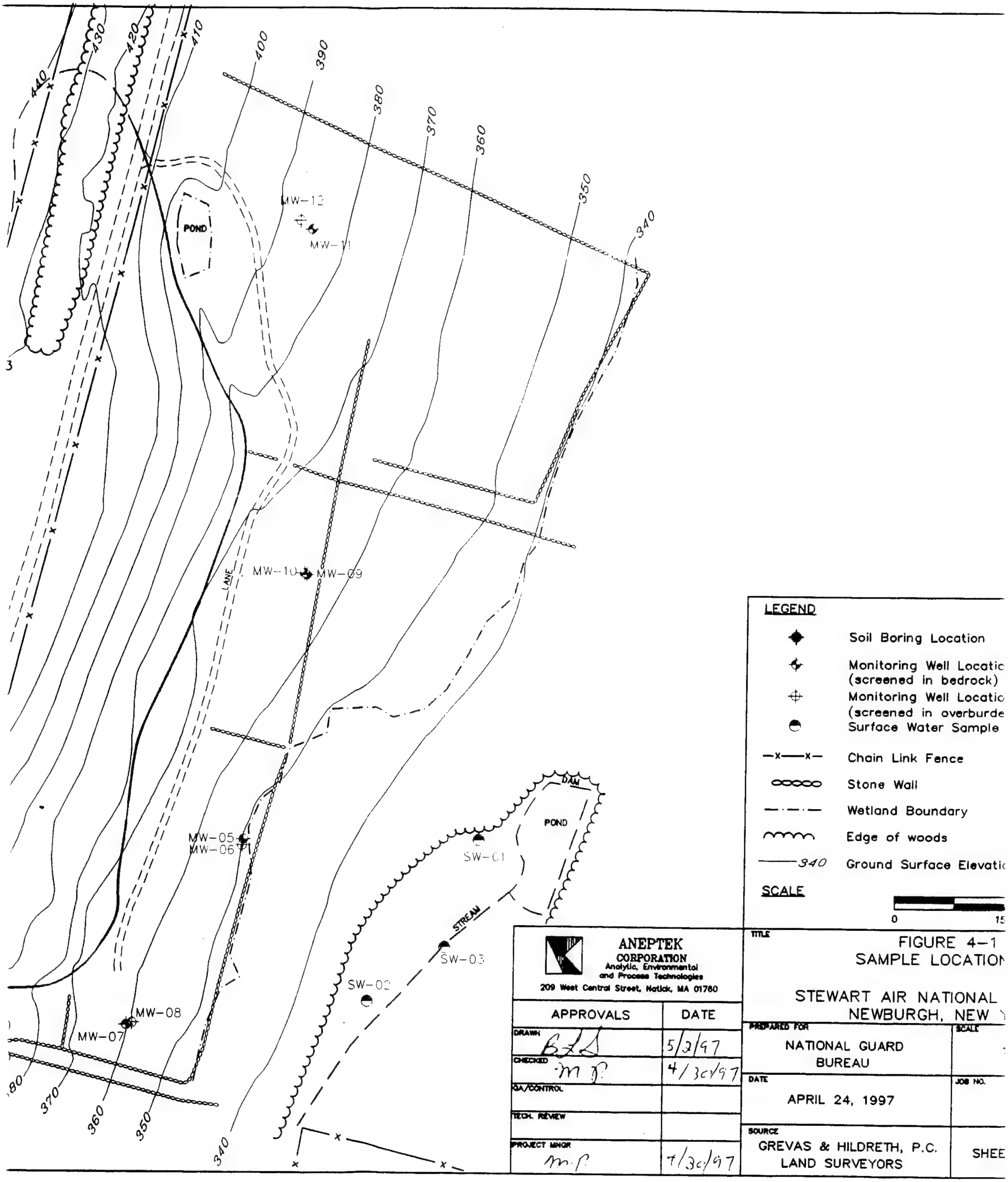
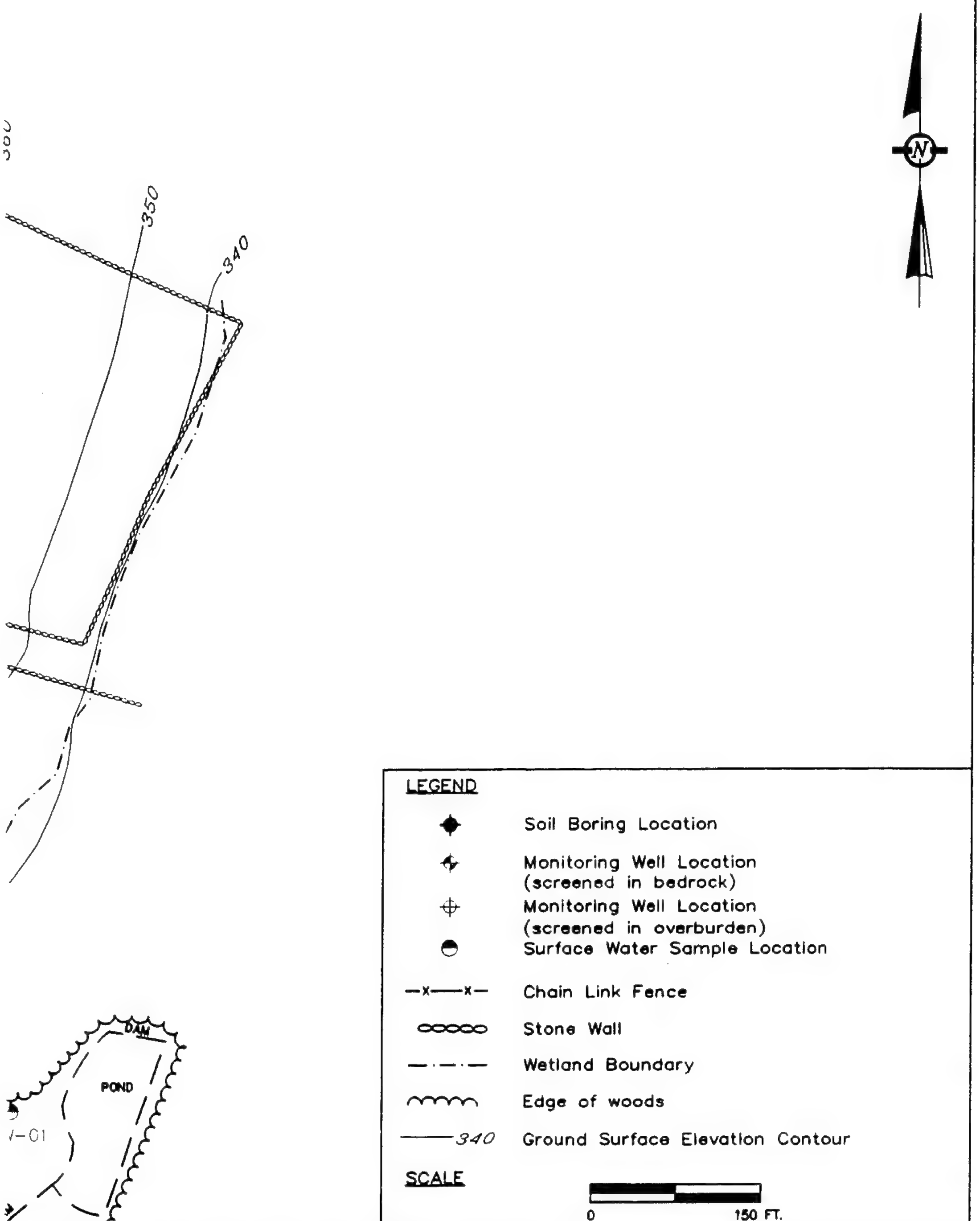

440
430
420
410
400
390
380
370
360
350
340
POND
MW-12
MW-11
LANE
MW-10
MW-09
MW-05
MW-06
MW-08
MW-07
DAM
POND
SW-01
STREAM
SW-03
SW-02
LEGEND
Soil Boring Location
Monitoring Well Locatic (screened in bedrock)
Monitoring Well Locatic (screened in overburde
Surface Water Sample
Chain Link Fence
Stone Wall
Wetland Boundary
Edge of woods
340 Ground Surface Elevatic
SCALE
0
15
ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
APPROVALS
DATE
DRAWN
5/2/97
CHECKED
4/30/97
QA/CONTROL
TECH. REVIEW
PROJECT MNGR
4/30/97
TITLE
FIGURE 4-1
SAMPLE LOCATION
STEWART AIR NATIONAL
NEWBURGH, NEW
PREPARED FOR
NATIONAL GUARD BUREAU
SCALE
DATE
APRIL 24, 1997
JOB NO.
SOURCE
GREVAS & HILDRETH, P.C. LAND SURVEYORS
SHEE

2



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TITLE
FIGURE 4–1
SAMPLE LOCATIONS

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

APPROVALS	DATE
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CHECKED M.P.	4/30/97
QA/CONTROL	
TECH. REVIEW	
PROJECT MNGR M.P.	4/30/97

PREPARED FOR: NATIONAL GUARD BUREAU

SCALE: 1 IN. = 150 FT.

DATE: APRIL 24, 1997

JOB NO.

SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS

SHEET 1 OF 1

3

considered to be representative of background conditions. Monitoring wells MW-01, MW-09, and MW-10 were installed as part of other on-going IRP activities at the Base. All wells were developed by surging with a surge block, followed by pumping with a check-valve lift pump, in accordance with SOP No. 4 in Appendix C of the work plan (ANEPTEK, 1995b).

4.3.6 In-situ Aquifer Testing

In-situ (slug) tests were performed on all wells installed for this investigation, to provide an estimate of aquifer hydraulic conductivity. Slug tests were performed on 7 wells installed as part of the CI field program. Data from an additional 4 wells, which were tested as part of other on-going IRP activities, were used in conjunction with the CI wells to provide a more complete set of aquifer hydraulic conductivity data points. The basic test procedure is described in several papers in the technical literature, including Bouwer and Rice (1976) as well as SOP No. 11 in Appendix C of the work plan (ANEPTEK, 1995b).

The test data were recorded with a In-Situ® Hermit 2000 digital data logger connected to a pressure transducer via a cable. After the test was completed, the data were downloaded from the data logger to a computer for storage and analyzed in the office by the Bouwer and Rice slug test analytical procedure (Bouwer, 1989). See Section 5.1.2.4 for a detailed discussion of analytical methods and results.

4.3.7 Groundwater Sampling

Monitoring wells were sampled with dedicated Teflon® bailers, in accordance with SOP No. 5 in Appendix C of the work plan (ANEPTEK, 1995b). All samples were submitted for off-site laboratory analysis for the parameters listed in Table 4-3.

4.3.8 Surface Water Sampling

Three surface water samples were collected from Murphy's Gulch to determine whether the landfill may be adversely impacting surface water quality in the nearby stream. All surface water samples were collected by filling the sample containers directly from the stream, in accordance with the work plan (ANEPTEK, 1995b). Surface water samples were submitted to the offsite laboratory for chemical analysis for the parameters listed in Table 4-2. Surface water sample locations are presented in Figure 4-1.

At the time of sample collection, two surface water bodies were noted to be present in the vicinity of Murphy's Gulch. One of these surface water bodies, the one closer to the New Windsor Landfill, appeared to be a man-made drainage swale. These two surface water bodies both empty into the small sedimentation pond, with the overflow from this pond forming Murphy's Gulch. As it was unclear as to which of these surface water bodies was the actual upstream portion of Murphy's Gulch, one of the three surface water samples was collected from the apparent man-made drainage swale. In collecting the two samples from the apparent natural Murphy's Gulch, the first sample was collected from a location downstream of the area in which

any influence from the landfill would be introduced. The second sample was collected upstream of the area from which impacts from the landfill would be introduced and is considered a background sample. The sample collected from the apparent man-made drainage swale was collected from the approximate mid-point, at which any influences from the landfill would be expected to be introduced.

4.3.9 Vector Survey/Wetlands Delineation

In accordance with 6 NYCRR Part 360-2-15(a)(4) a vector survey was performed over the entire landfill. In general, this survey included performing an inspection of the landfill and surrounding area for evidence of potential disease carrying (i.e., mice, rats, etc.) and burrowing animals (i.e., rabbits, groundhogs, etc.). Any evidence indicating the presence of such creatures, was to be noted and further evaluated to determine if an estimate of the species population could be obtained.

Also, to preclude landfill cover construction operations from infringing on adjacent wetlands, the boundary of the wetlands associated with Murphy's Gulch were delineated. Wetlands in the vicinity of Site 1 were delineated in accordance with the guidelines set forth in the Army Corps of Engineers Wetland Delineation Manual (USACE, 1987).

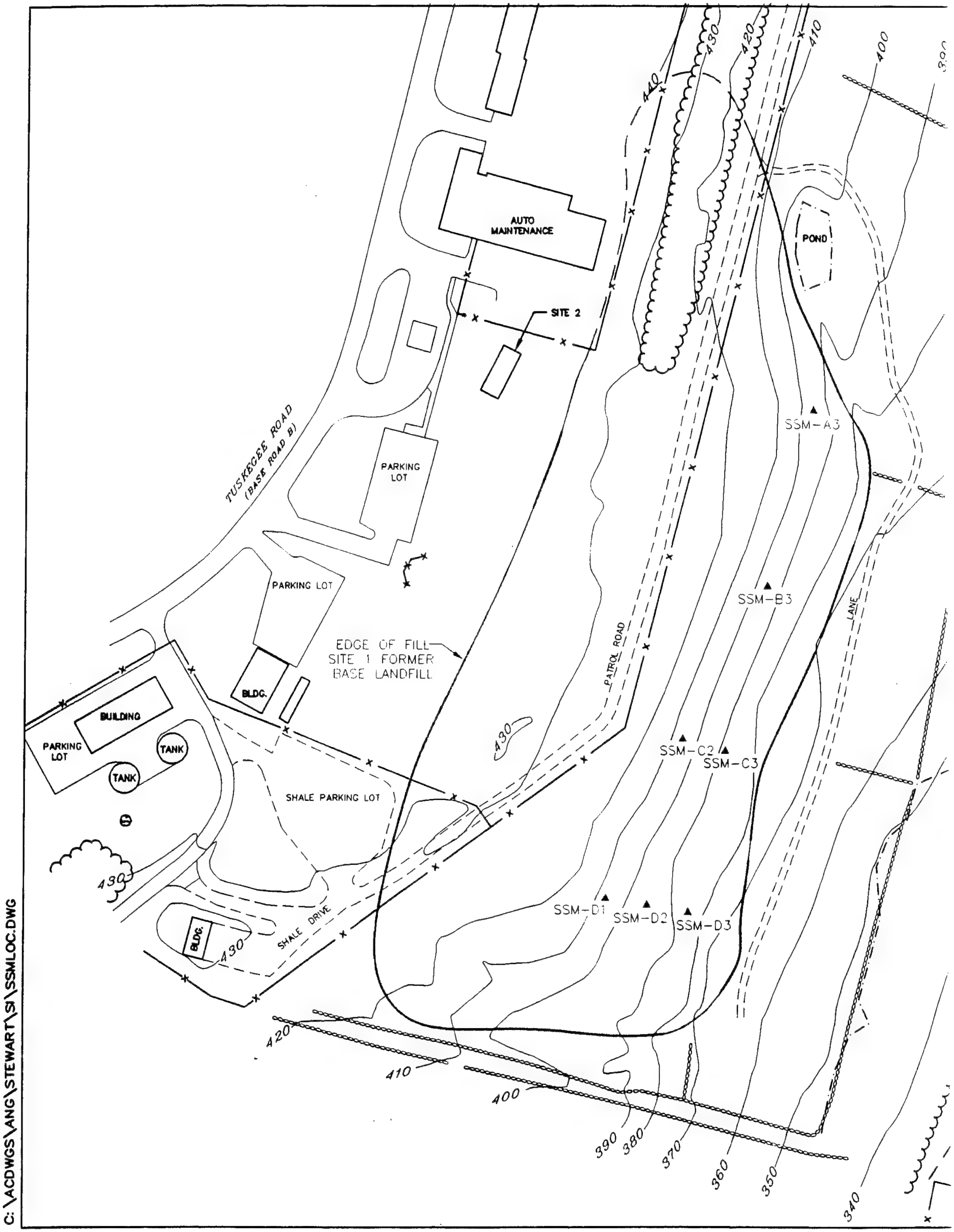
4.3.10 Evaluation of Slope Stability

In order to monitor the fill material for overall stability of the fill material, slope stability monuments were installed over the steep eastern side slope of Site 1. Seven slope stability monuments were installed on June 13, 1995. Figure 4-2 presents the slope stability monument locations. Each monument was constructed of 4-inch steel piping which was hammered into the existing interim landfill cover. Initially, 12 monuments were intended to be installed over the side slope, as proposed in the Technical Memorandum submitted by ANEPTEK in June 1995 (ANEPTEK, 1995a). However, due to difficulty (i.e., refusal) advancing the 4-inch piping to sufficient depth, five of the monuments were not installed. The 7 monuments which were successfully installed provide sufficient data to evaluate the stability of the side slope.

To provide control points from which the slope stability monuments could be referenced, a traverse was set up around the landfill perimeter. An arbitrary coordinate system was then set up by assigning the northing (N) and easting (E) coordinates (0N,0E) to one of the traverse points, and using an assumed direction of north. The slope stability monuments were then surveyed three times over the period of a year to monitor any movement of the fill material.

4.3.11 Evaluation of Settlement Characteristics

Three concrete settlement pads were constructed near the top break in the landfill slope. Each pad was constructed of cast-in-place concrete with two steel pipe risers as described in the Work Plan (ANEPTEK, 1995b). Figure 4-3 presents the settlement pad locations. The same control points and coordinate system set up for the slope stability monuments was used to monitor the


AUTO MAINTENANCE
SITE 2
POND
TUSKEGEE ROAD (BASE ROAD B)
PARKING LOT
PARKING LOT
EDGE OF FILL SITE 1 FORMER BASE LANDFILL
BLDG.
BUILDING
PARKING LOT
TANK
TANK
SHALE PARKING LOT
SHALE DRIVE
BLDG.
PATROL ROAD
LANE
SSM-A3
SSM-B3
SSM-C2
SSM-C3
SSM-D1
SSM-D2
SSM-D3
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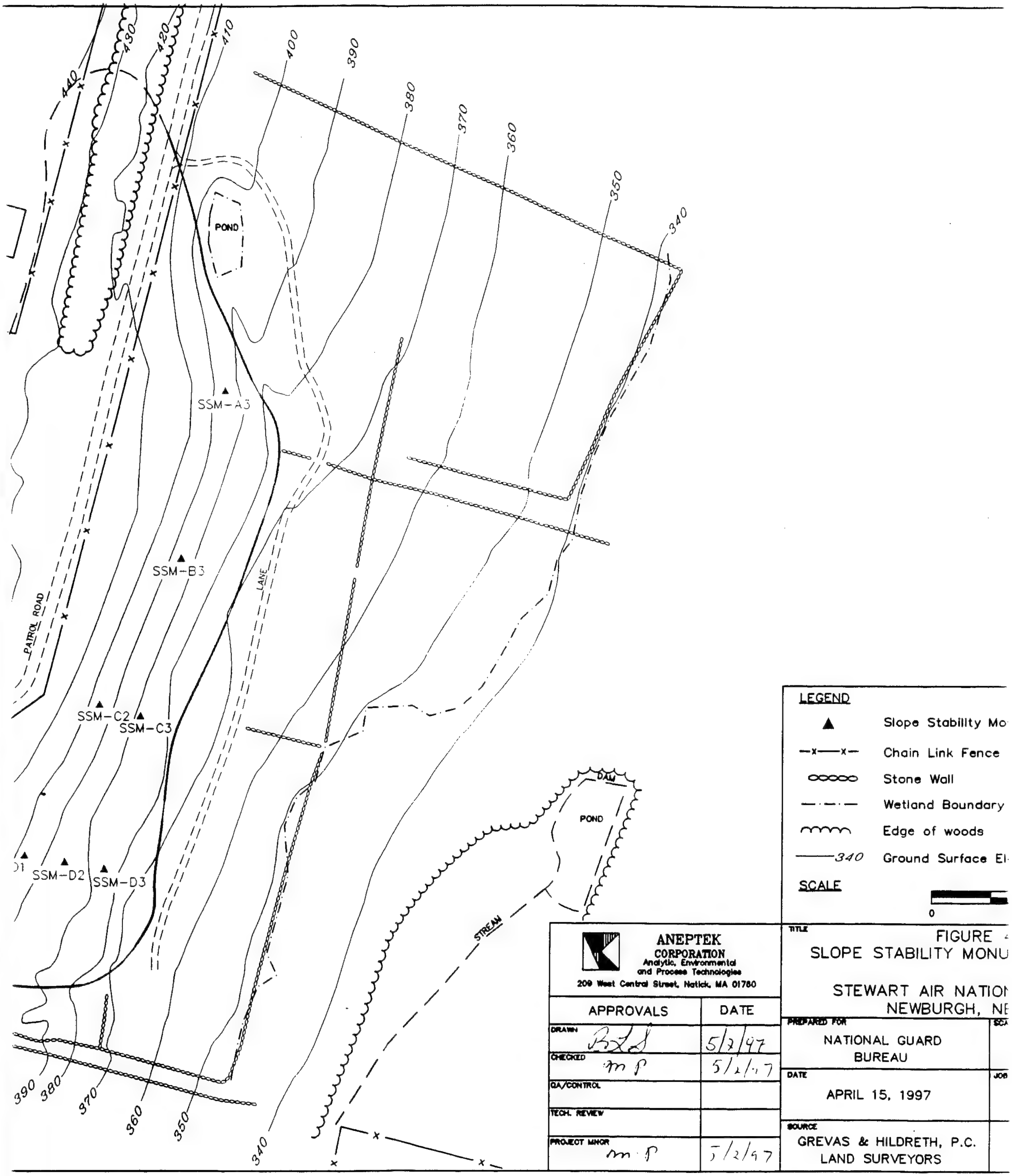

400
390
380
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360
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440
430
420
410
POND
SSM-A3
SSM-B3
SSM-C2
SSM-C3
SSM-D2
SSM-D3
PATROL ROAD
LANE
DAM
POND
STREAM
390
380
370
360
350
340
LEGEND
Slope Stability Mo
Chain Link Fence
Stone Wall
Wetland Boundary
Edge of woods
340
Ground Surface El
SCALE
0
ANEPTEK
CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
APPROVALS
DATE
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FIGURE
SLOPE STABILITY MONU
STEWART AIR NATIO
NEWBURGH, N
PREPARED FOR
NATIONAL GUARD
BUREAU
DATE
APRIL 15, 1997
SOURCE
GREVAS & HILDRETH, P.C.
LAND SURVEYORS

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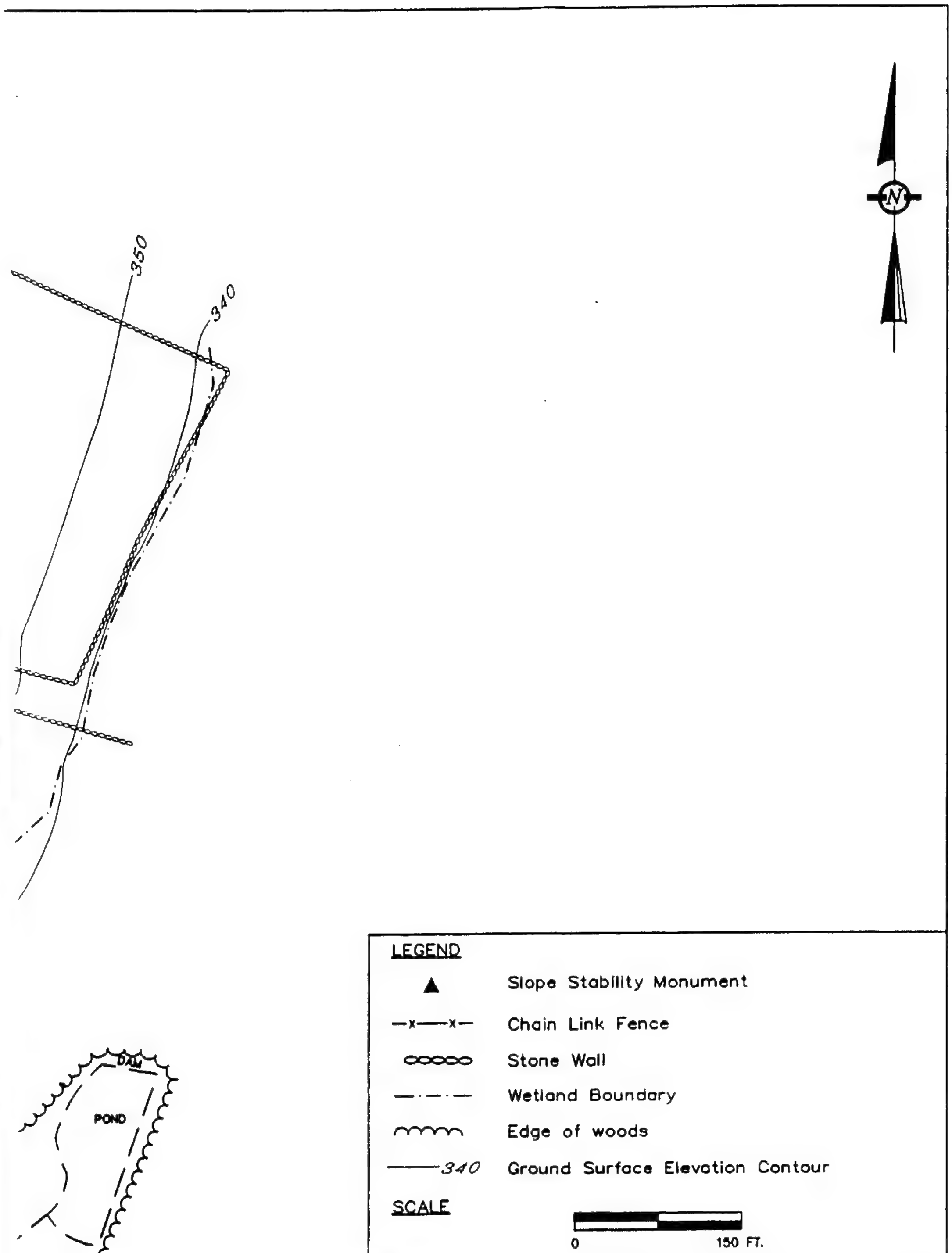

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TITLE
FIGURE 4–2
SLOPE STABILITY MONUMENT LOCATIONS

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

APPROVALS	DATE
DRAWN BJS	5/2/97
CHECKED mP	5/2/97
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PROJECT MNGR mP	5/2/97

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DATE: APRIL 15, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

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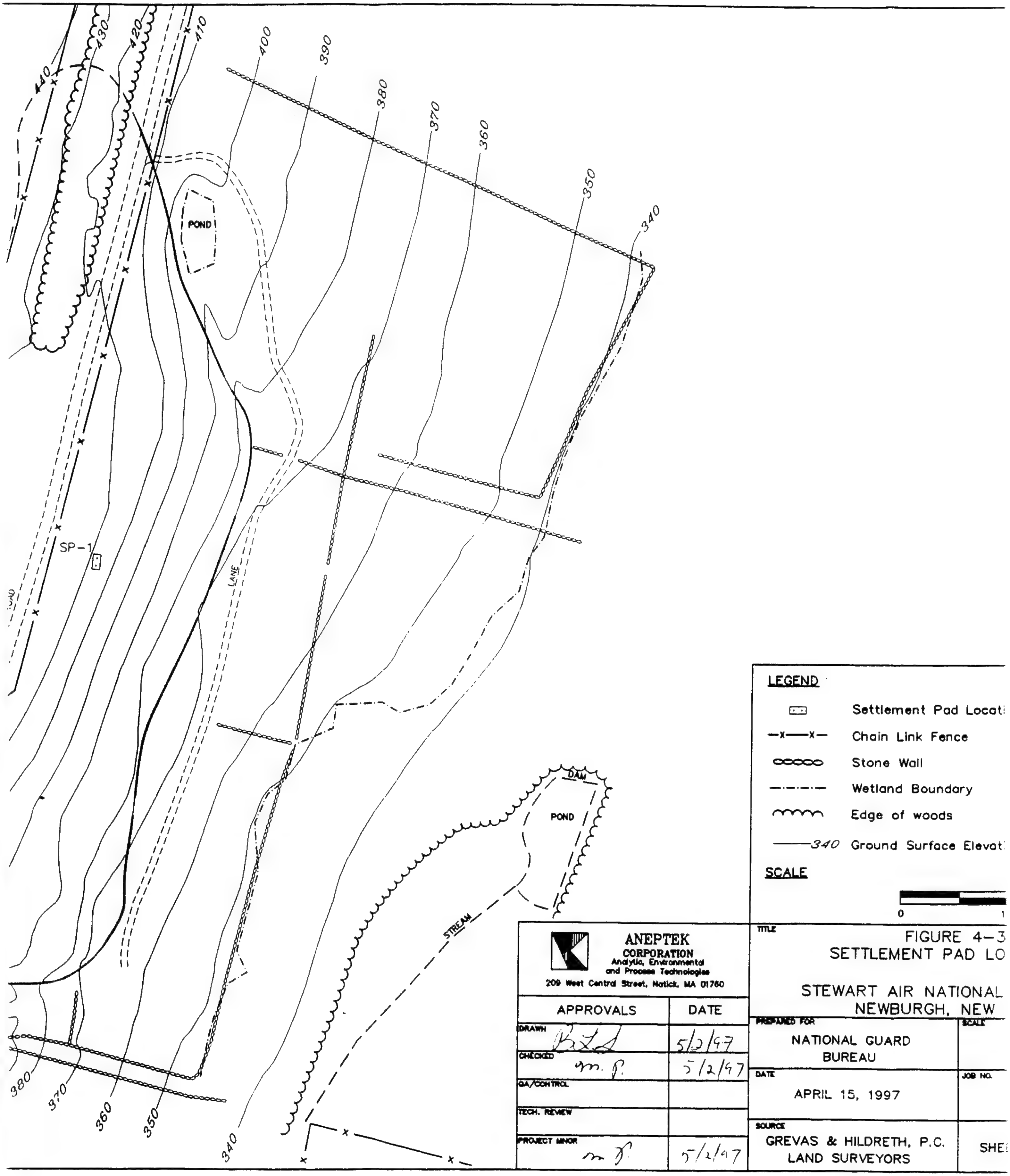

LEGEND

Settlement Pad Locati

Chain Link Fence

Stone Wall

Wetland Boundary

Edge of woods

340 Ground Surface Elevat

SCALE

0 1

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TITLE
FIGURE 4-3
SETTLEMENT PAD LO

STEWART AIR NATIONAL
NEWBURGH, NEW

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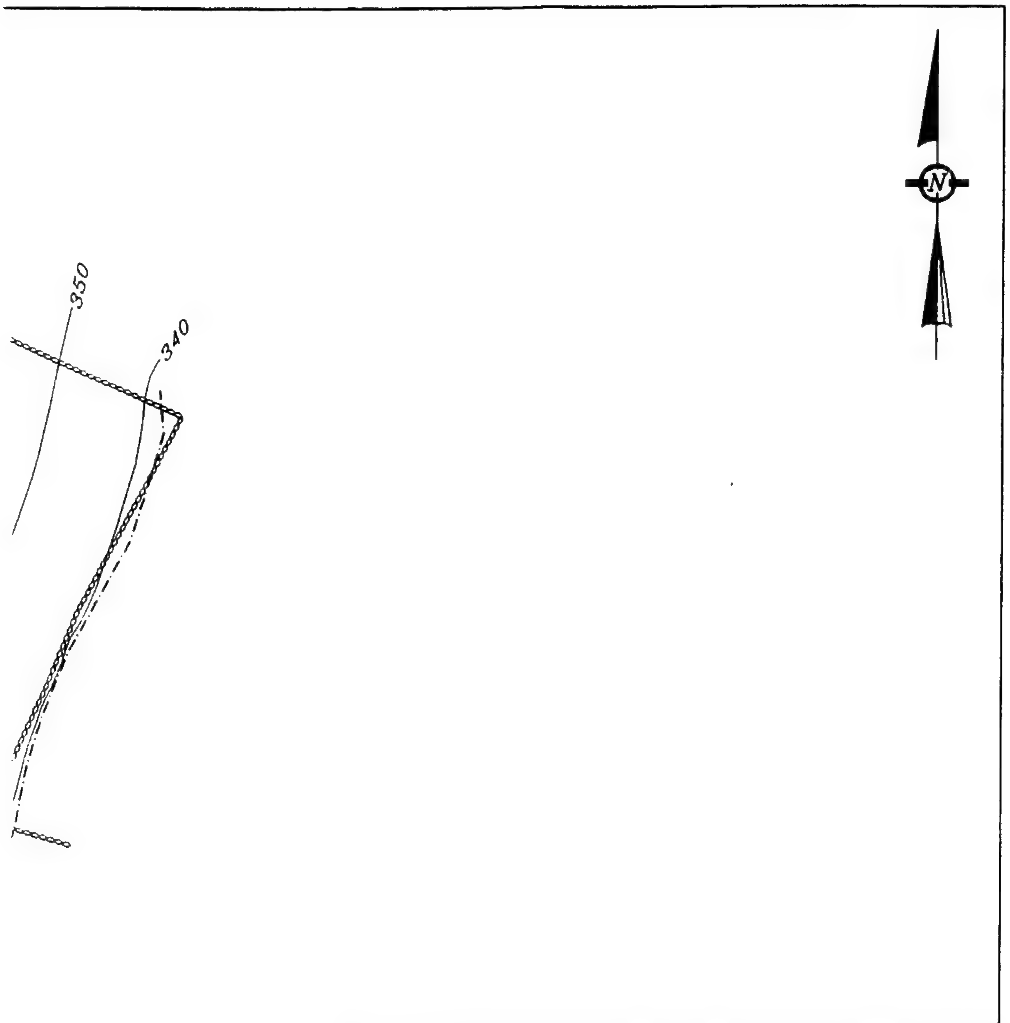

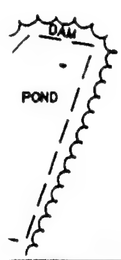

LEGEND

⬚	Settlement Pad Location
—x——x—	Chain Link Fence
ooooo	Stone Wall
—·—·—	Wetland Boundary
⌒⌒⌒	Edge of woods
——340	Ground Surface Elevation Contour

SCALE

0 150 FT.

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REVIEW	
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FIGURE 4–3
SETTLEMENT PAD LOCATIONS

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 15, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

3

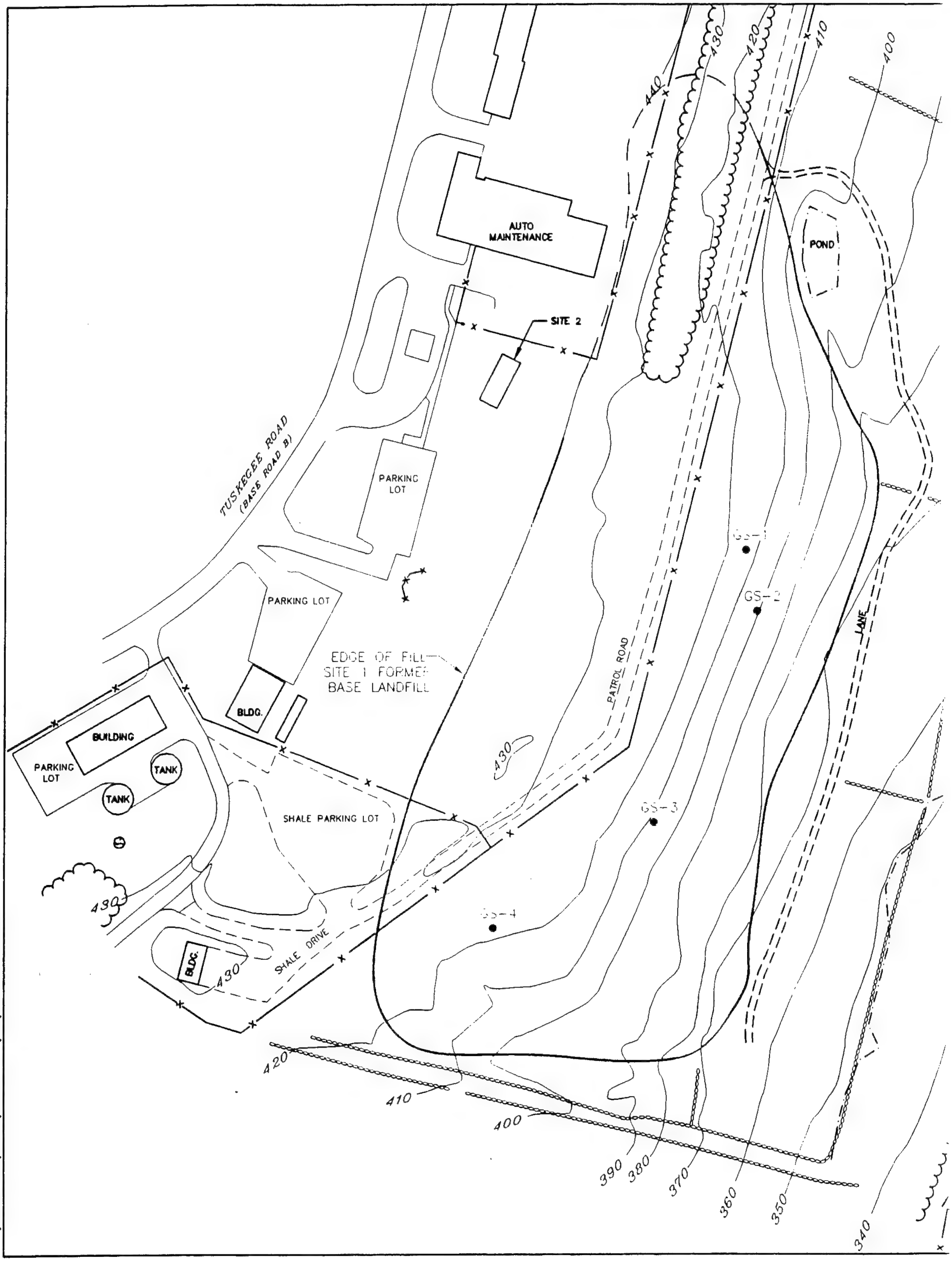
settlement pads. Settlement pads were also monitored for elevation changes based on an arbitrary datum of 100 feet, assumed at a nearby hydrant.

4.3.12 Side Slope Soil Sampling and Permeability Evaluation

In addition to the work outlined in the Work Plan (ANEPTEK, 1995b), a preliminary evaluation of the existing interim cover on the side slope of the landfill was performed. This evaluation was performed to support engineering design analysis to determine the appropriate closure approach for the landfill. The evaluation of the existing cover consisted of using hand shovels to dig through the interim cover to determine the minimum thickness of the cover. Samples of the soils removed during this activity were placed into 5 gallon buckets and submitted to a geotechnical laboratory for grain size distribution analysis including sieve and hydrometer testing. Figure 4-4 presents the approximate locations from which these samples were collected.

4.3.13 Surveying

Test pits, staff gages, monitoring wells and ground surface topography were surveyed by a New York Licensed Land Surveyor. Accuracy of the survey was within 0.01 feet for vertical measurements; 0.1 feet for horizontal measurements. The survey was performed by Grevas & Hildreth, P.C. Land Surveyors.



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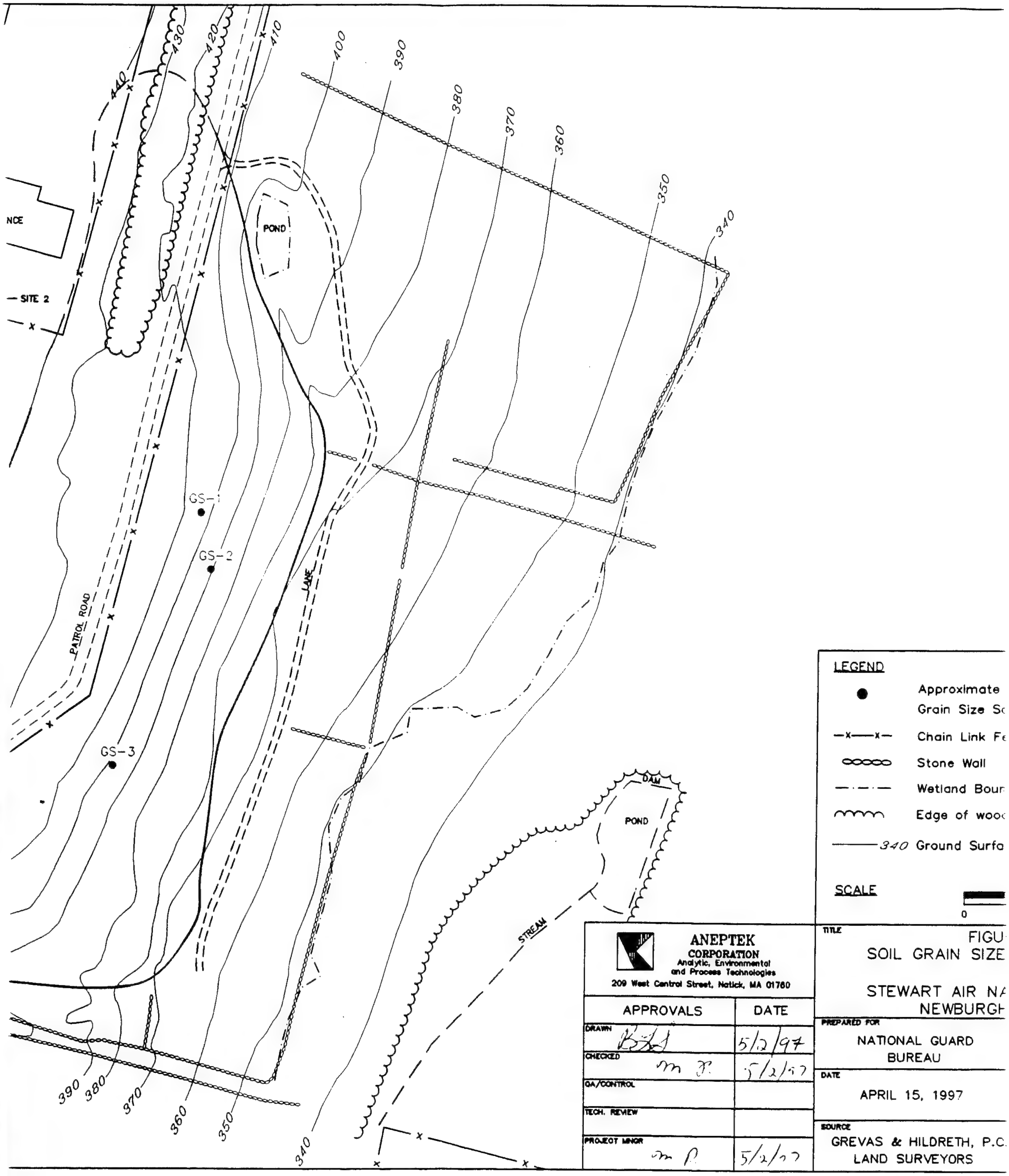

NCE
SITE 2
POND
GS-1
GS-2
GS-3
PATROL ROAD
LANE
DAM
POND
STREAM
440
430
420
410
400
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380
370
360
350
340
LEGEND
Approximate Grain Size Sc
Chain Link Fe
Stone Wall
Wetland Bour
Edge of wooc
340 Ground Surfa
SCALE
0
ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
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PROJECT MNGR
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FIGU
SOIL GRAIN SIZE
STEWART AIR NA
NEWBURGH
PREPARED FOR
NATIONAL GUARD BUREAU
DATE
APRIL 15, 1997
SOURCE
GREVAS & HILDRETH, P.C. LAND SURVEYORS

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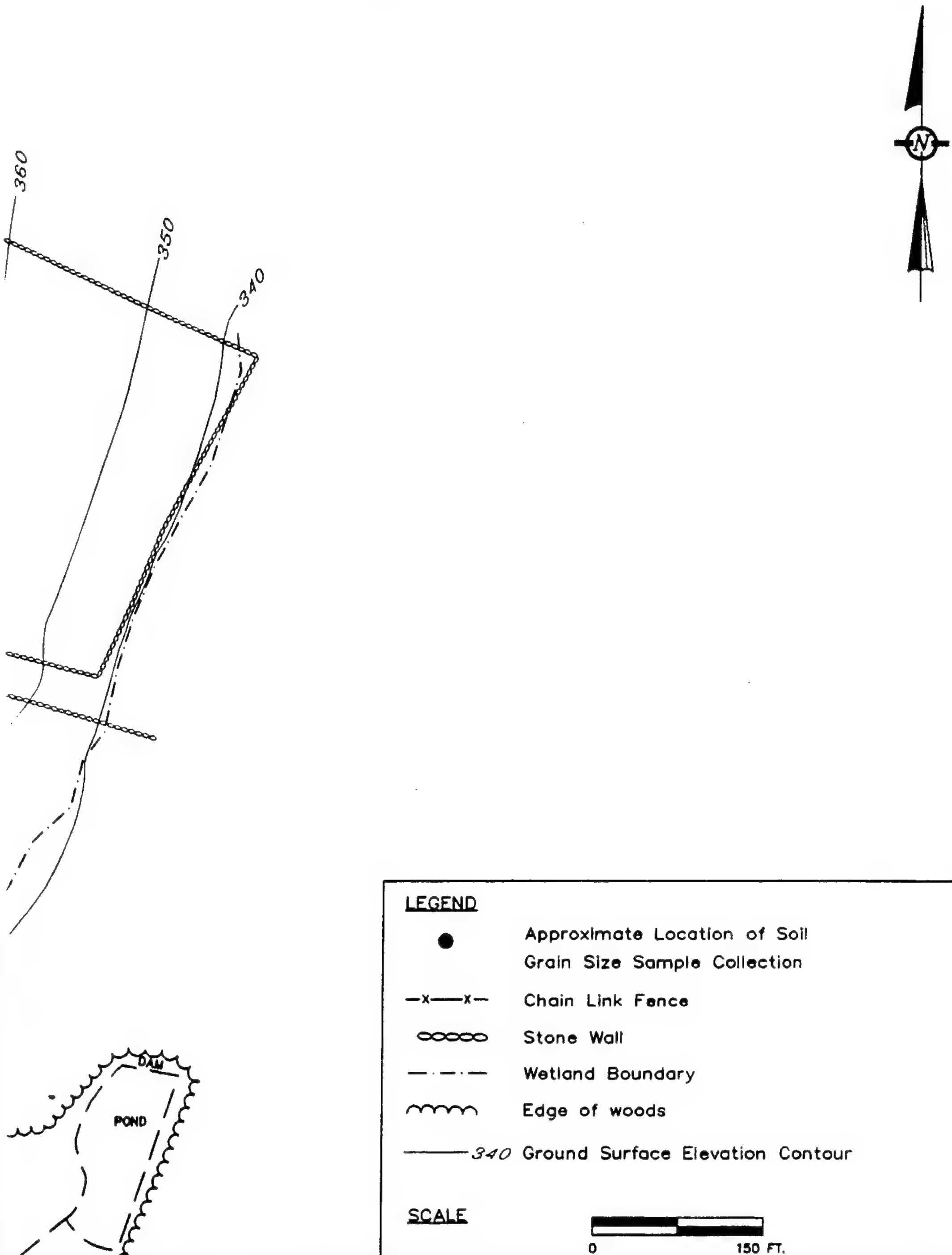

LEGEND

- ● Approximate Location of Soil Grain Size Sample Collection
- —x——x— Chain Link Fence
- ○○○○○ Stone Wall
- —·—·— Wetland Boundary
- ⌒⌒⌒⌒ Edge of woods
- ———340 Ground Surface Elevation Contour

SCALE

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FIGURE 4–4
SOIL GRAIN SIZE SAMPLE LOCATIONS

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 15, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

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SECTION 5.0

5.0 INVESTIGATION FINDINGS

The results of the CI are presented in this section. Section 5.1 provides the study area geologic and hydrologic results and interpretations. Section 5.2 presents the results of background sampling analyses. Section 5.3 discusses the results of all geotechnical field work as well as analytical laboratory analyses.

5.1 Site Geologic and Hydrologic Investigation Results

This section discusses the geologic and hydrologic findings of the CI. Data from the associated RI at Site 2 are also included for completeness. Supporting data from previous investigations are found in Appendix A. Boring logs and monitoring well construction diagrams generated during the investigations of Sites 1 and 2 are provided in Appendices D and E, respectively. Appendix F contains all water level data and associated calculations derived from that data. In-situ permeability test data and analyses are provided in Appendix G.

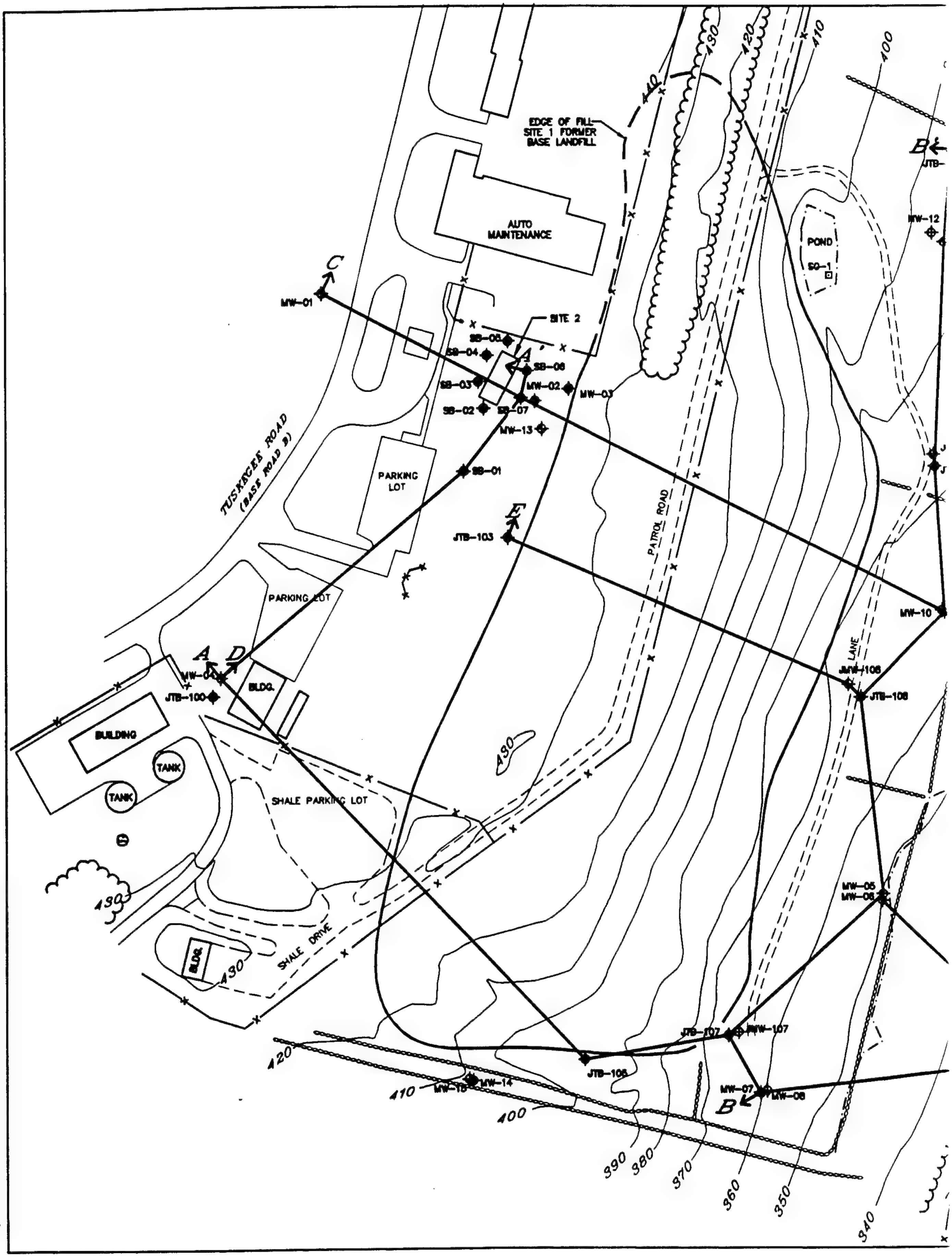
5.1.1 Geology

Locations of cross sections that illustrate the geology of the study area are shown on Figure 5-1. Cross sections A-A' through E-E' are provided on Figures 5-2 through 5-6.

5.1.1.1 Surficial Geology

The lithology and character of overburden soil samples observed during the CI are consistent with descriptions from previous investigations (E.C. Jordan, 1989). The overburden is composed of lodgement glacial till that generally consists of grey, extremely dense clay and silt, some fine to medium, subangular to angular gravel, trace to little sand. Boulders are occasionally encountered at depth. The lodgement till was sufficiently dense to prevent advancement of the borehole by hollow stem auger drilling in the vicinity of Site 1; therefore, borings were advanced by diamond bit coring and samples were collected with a 5-foot NX core barrel after auger refusal. The till has no visible porosity and is so compact that it appears cemented. Samples could be broken apart for detailed examination only with great difficulty. Although fractures in the till are suspected to be present, they are not visible in samples collected for this study.

As shown on Figures 5-2 and 5-4, the thickness of the lodgement till varies from 9 to 34.5 feet in the vicinity of Sites 1 and 2. The lodgement till becomes thinner and less dense from the west to the east side of Site 1, towards the toe of the slope (it was not observed at JTB-107) as shown on Figure 5-3 (a north-south cross section across the toe of the landfill) and Figures 5-4 and 5-5 (east west cross sections across the landfill). Although split spoons could be advanced through the less dense till, it was still considered lodgement till due to high blow counts (>40/ft) required to advance a sampler through the soil. The lodgement till is thought to



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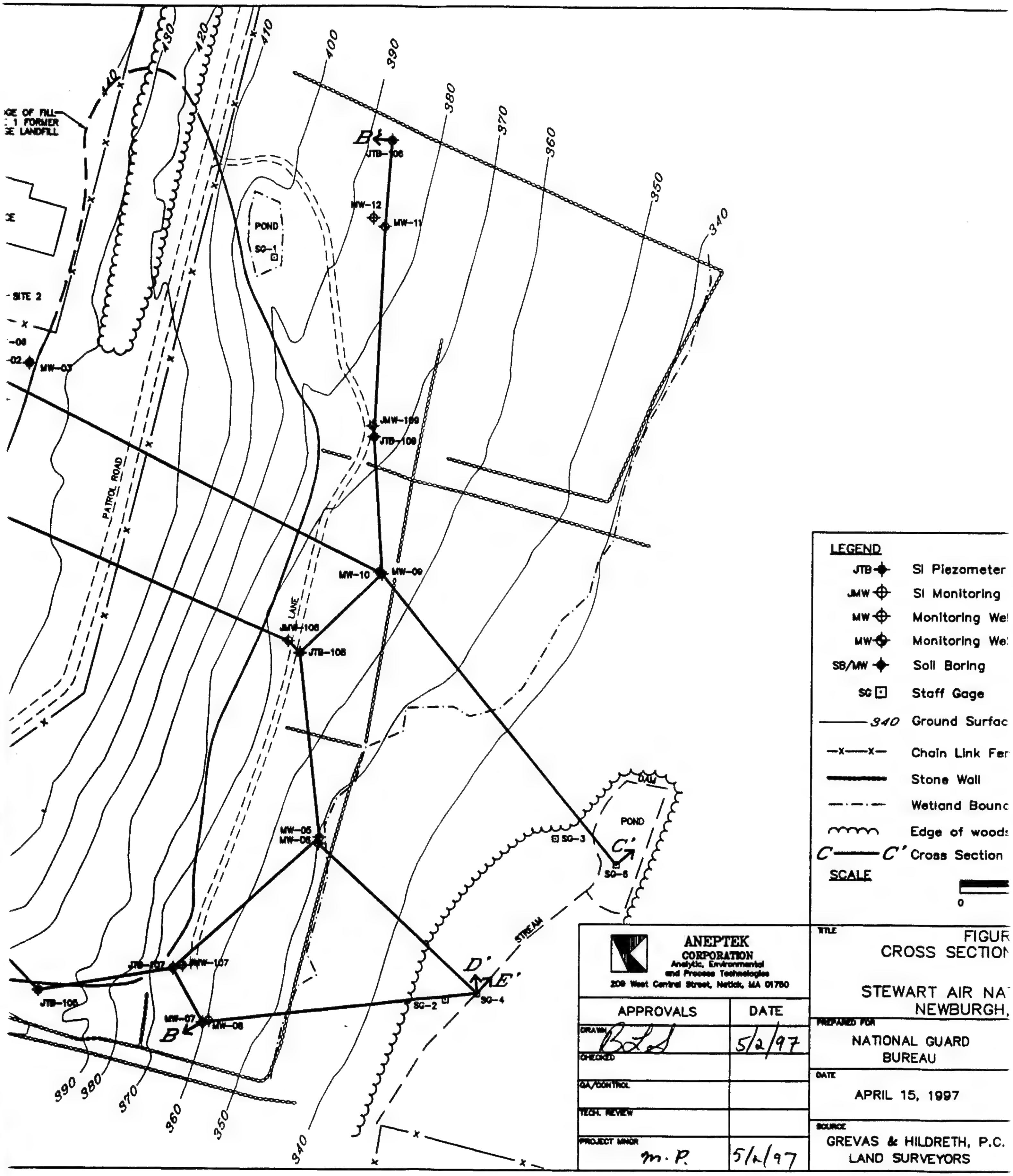

EDGE OF FILL- SITE 1 FORMER GE LANDFILL
SITE 2
POND
SG-1
MW-12
MW-11
JTB-106
B
PATROL ROAD
LANE
JMW-109
JTB-109
MW-10
MW-09
JMW-108
JTB-108
MW-05
MW-06
SG-3
POND
DAM
C'
SG-6
STREAM
JTB-107
JMW-107
JTB-105
MW-07
MW-08
SG-2
SG-4
D'
E'
MW-03
440
430
420
410
400
390
380
370
360
350
340
LEGEND
JTB SI Piezometer
JMW SI Monitoring
MW Monitoring We
MW Monitoring We
SB/MW Soil Boring
SG Staff Gage
340 Ground Surfac
Chain Link Fer
Stone Wall
Wetland Bounc
Edge of woods
C—C' Cross Section
SCALE
0
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STEWART AIR NA
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PREPARED FOR
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DATE
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SOURCE
GREVAS & HILDRETH, P.C. LAND SURVEYORS

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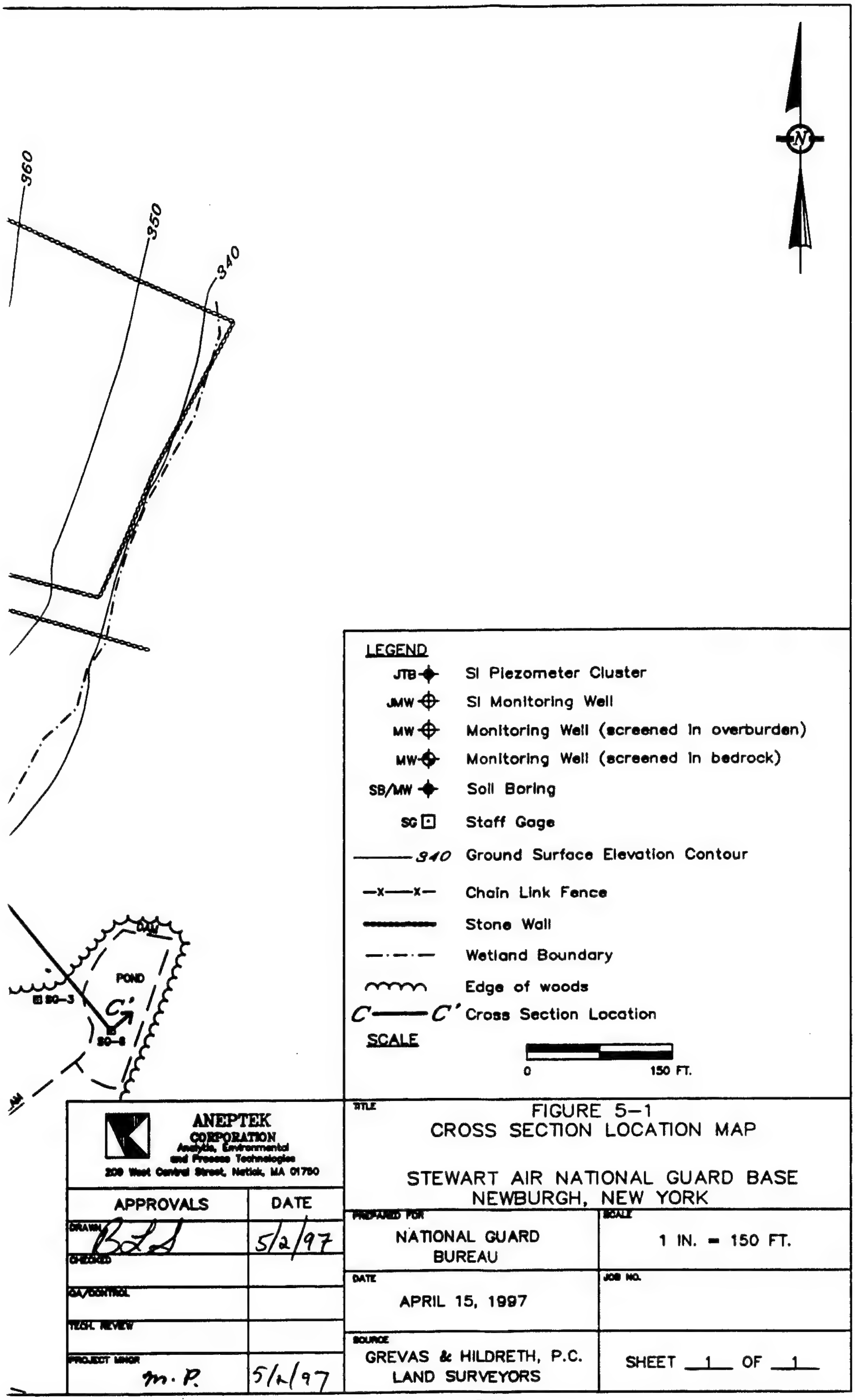
360
350
340
N
DAM
POND
SO-3
SO-6
C
C'
LEGEND
JTB SI Piezometer Cluster
JMW SI Monitoring Well
MW Monitoring Well (screened in overburden)
MW Monitoring Well (screened in bedrock)
SB/MW Soil Boring
SG Staff Gage
340 Ground Surface Elevation Contour
—x—x— Chain Link Fence
Stone Wall
Wetland Boundary
Edge of woods
C——C' Cross Section Location
SCALE
0
150 FT.
ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
APPROVALS
DATE
DRAWN BLS 5/2/97
CHECKED
QA/CONTROL
TECH. REVIEW
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TITLE
FIGURE 5–1
CROSS SECTION LOCATION MAP
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK
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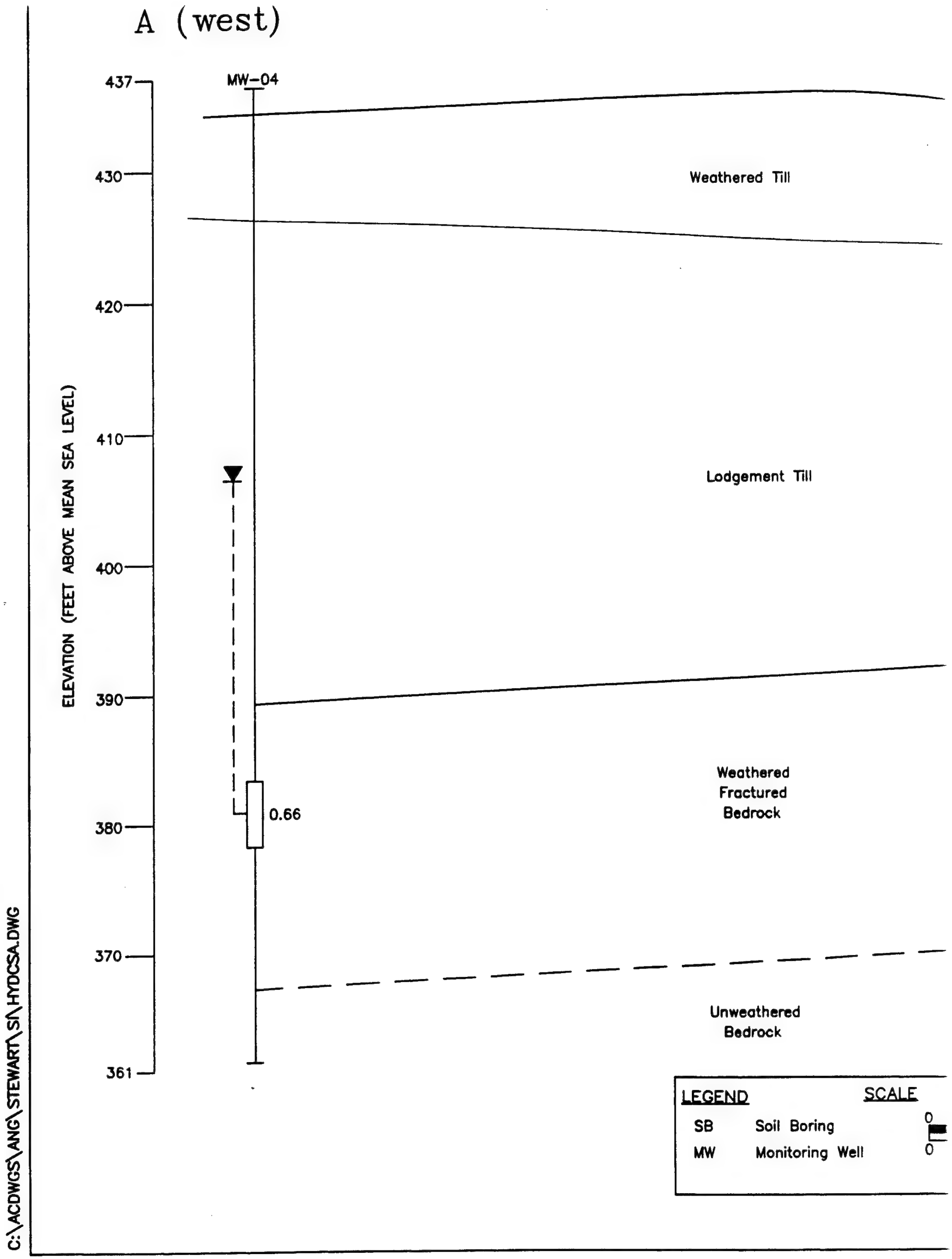
NATIONAL GUARD BUREAU
SCALE
1 IN. = 150 FT.
DATE
APRIL 15, 1997
JOB NO.
SOURCE
GREVAS & HILDRETH, P.C. LAND SURVEYORS
SHEET 1 OF 1

3


A (west)
MW-04
437
430
420
410
400
390
380
370
361
ELEVATION (FEET ABOVE MEAN SEA LEVEL)
Weathered Till
Lodgement Till
0.66
Weathered
Fractured
Bedrock
Unweathered
Bedrock
LEGEND
SB Soil Boring
MW Monitoring Well
SCALE
0
0
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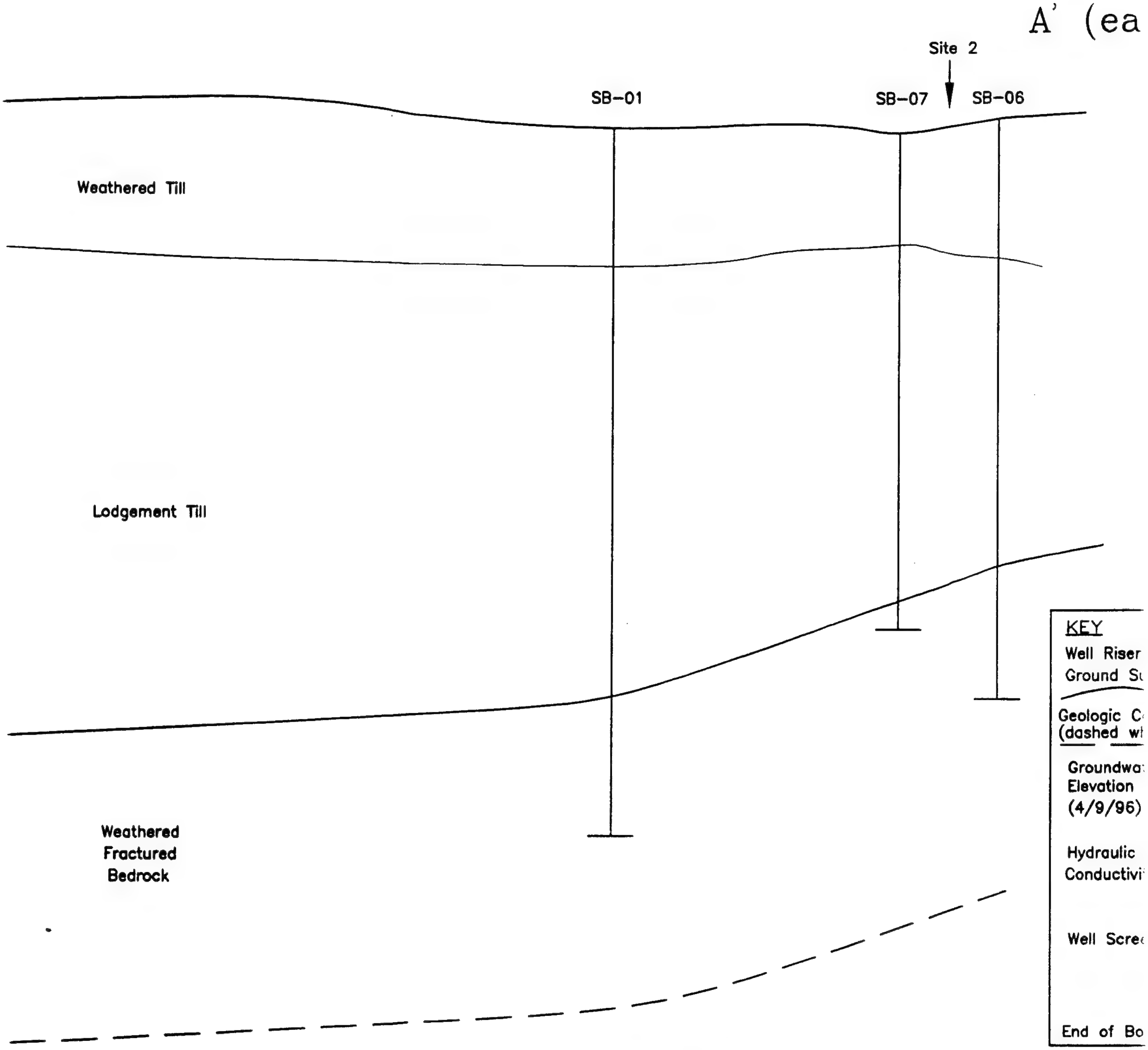
1



LEGEND

SB	Soil Boring
MW	Monitoring Well

SCALE

Horizontal: 0 — 50 FT.

Vertical: 0 — 10 FT.

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TECH. REVIEW	
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TITLE: FIGURE 5–
HYDROGEOLOGIC CROSS
STEWART AIR NATIONA
NEWBURGH, NEW

PREPARED FOR: NATIONAL GUARD BUREAU

DATE: APRIL 15, 1997

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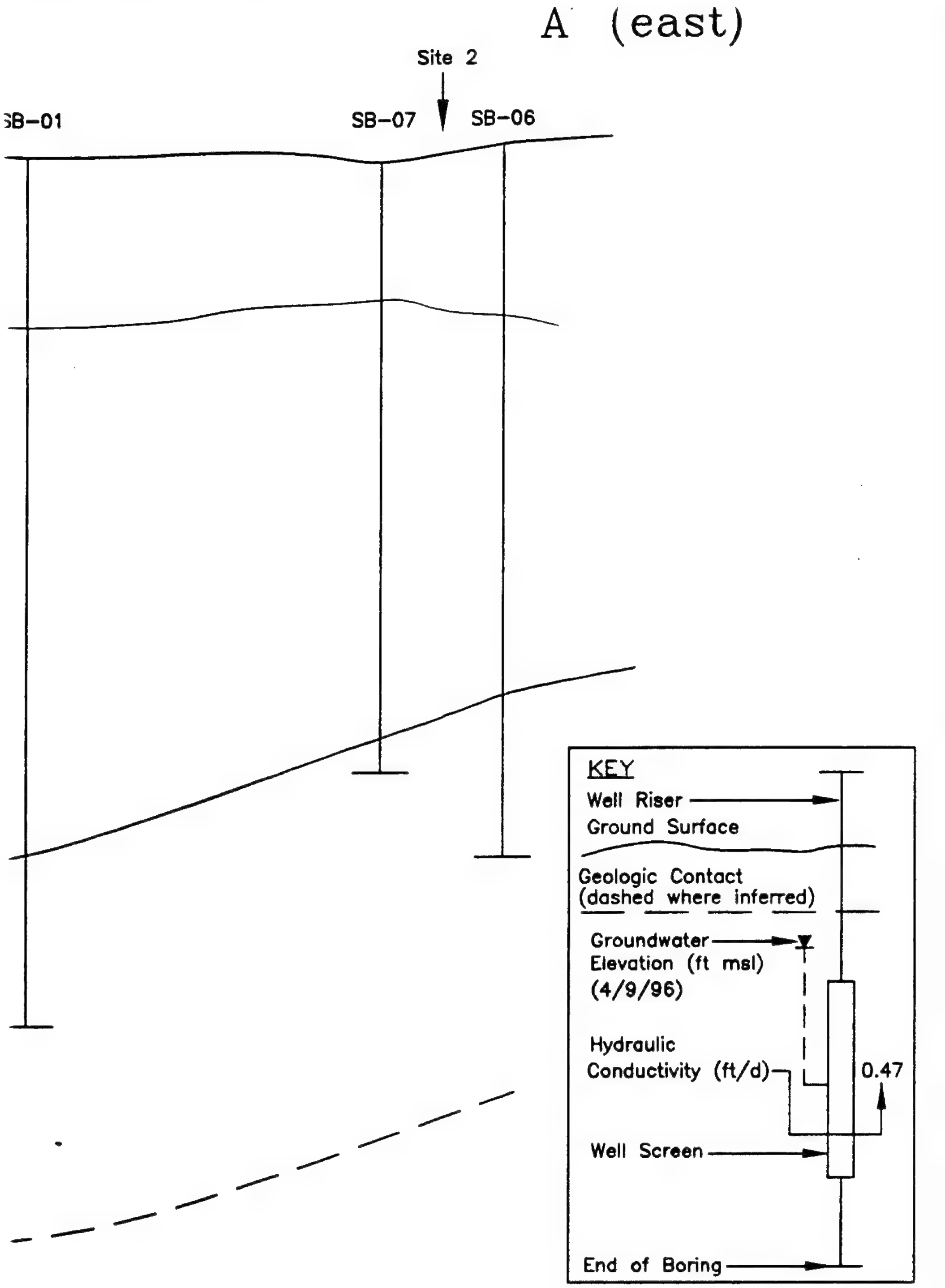

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TITLE
FIGURE 5-2
HYDROGEOLOGIC CROSS SECTION A – A'
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

APPROVALS	DATE
DRAWN BZS	5/2/97
CHECKED	
QA/CONTROL	
TECH. REVIEW	
PROJECT MNGR m.p.	5/2/97

PREPARED FOR: NATIONAL GUARD BUREAU

SCALE: HORIZONTAL: 1 IN. = 50 FT. VERTICAL: 1 IN. = 10 FT.

DATE: APRIL 15, 1997

JOB NO.

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SHEET 1 OF 1

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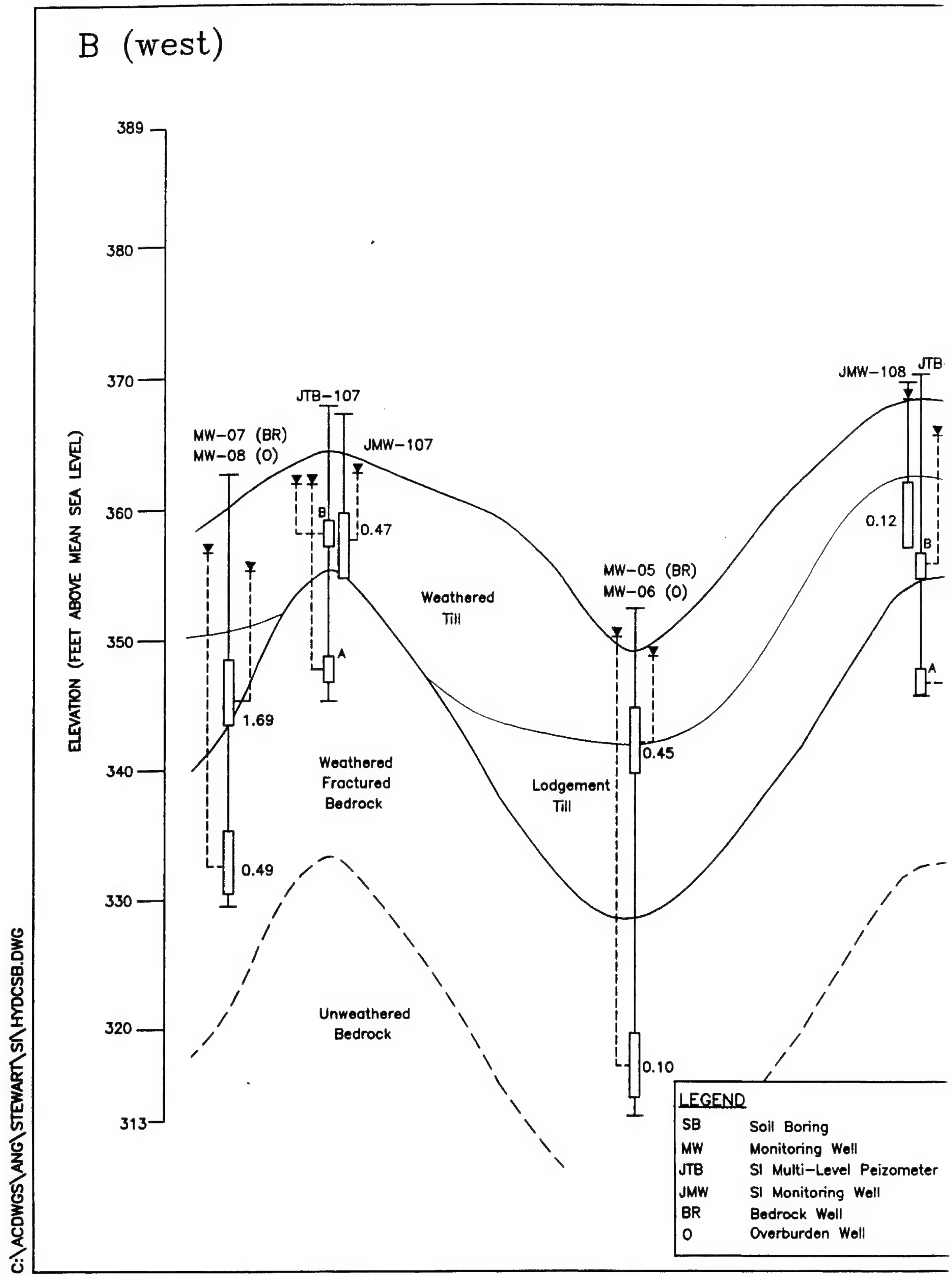

B (west)
ELEVATION (FEET ABOVE MEAN SEA LEVEL)
389
380
370
360
350
340
330
320
313
MW-07 (BR)
MW-08 (O)
JTB-107
JMW-107
JMW-108
JTB
MW-05 (BR)
MW-06 (O)
1.69
0.49
0.47
0.45
0.10
0.12
B
A
Weathered Till
Weathered Fractured Bedrock
Lodgement Till
Unweathered Bedrock
LEGEND
SB Soil Boring
MW Monitoring Well
JTB SI Multi-Level Peizometer
JMW SI Monitoring Well
BR Bedrock Well
O Overburden Well
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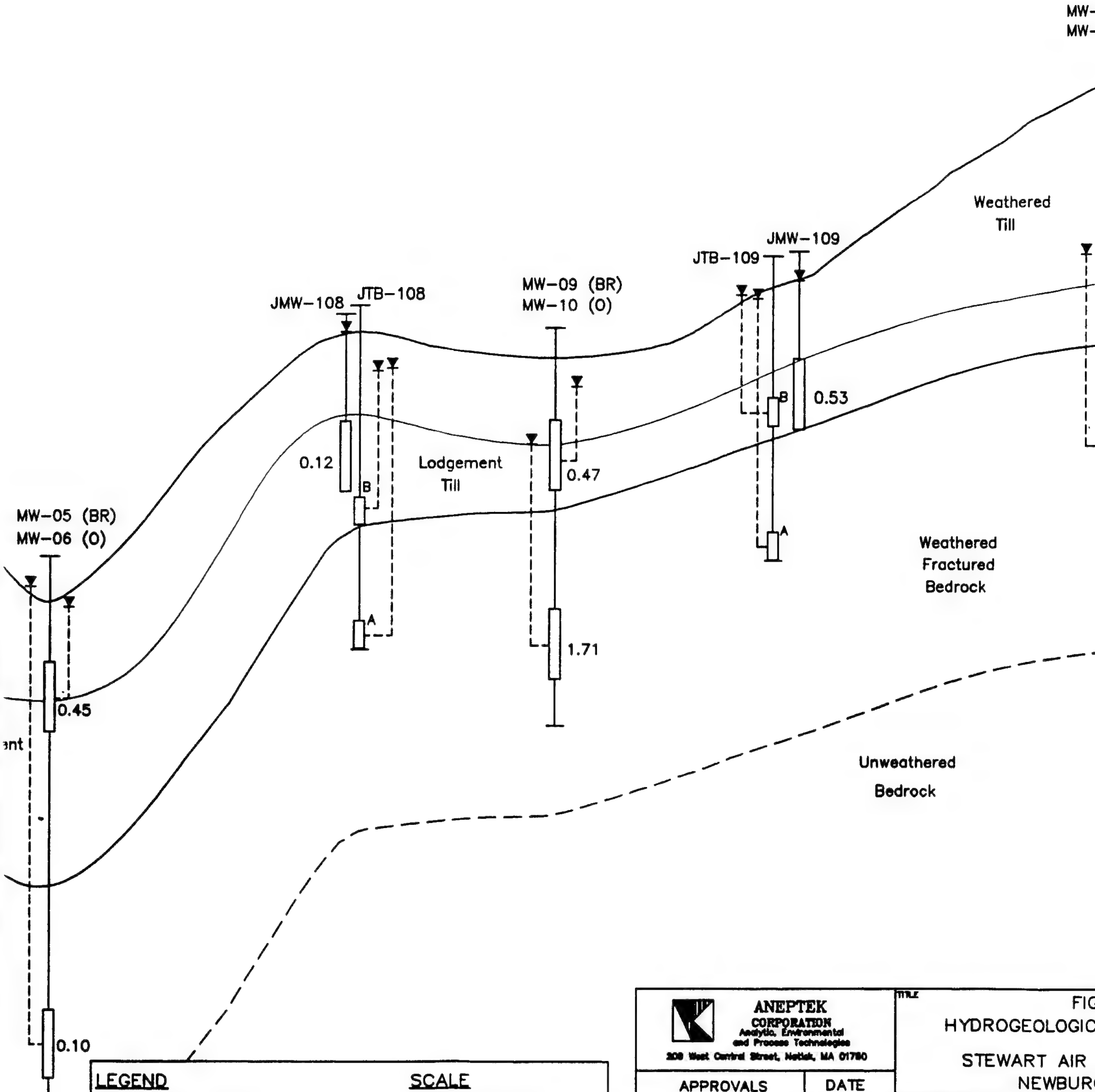
1



LEGEND

SB	Soil Boring
MW	Monitoring Well
JTB	SI Multi-Level Peizometer
JMW	SI Monitoring Well
BR	Bedrock Well
O	Overburden Well

SCALE

Horizontal
0 100 FT.
0 10 FT.
Vertical

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and Process Technologies
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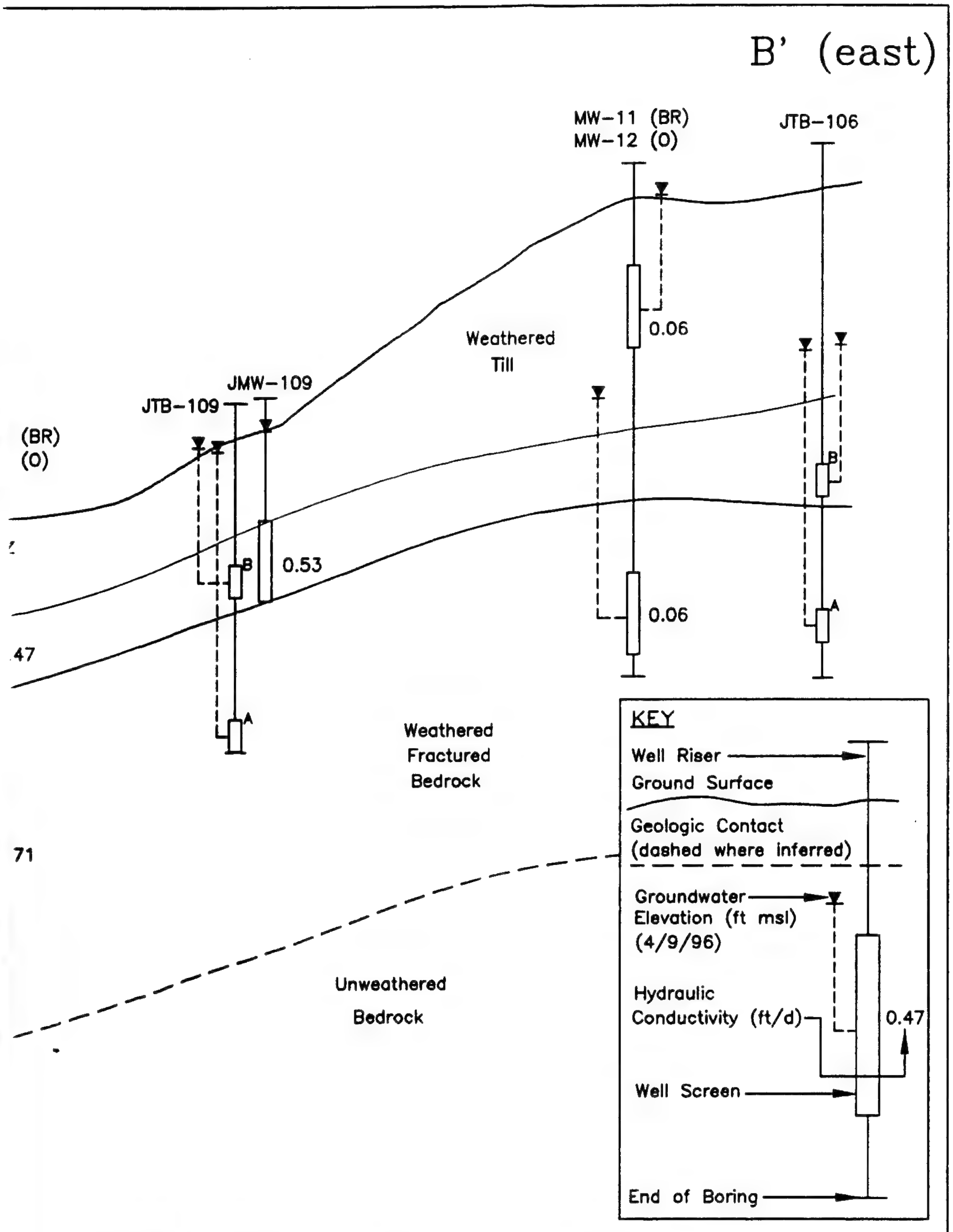

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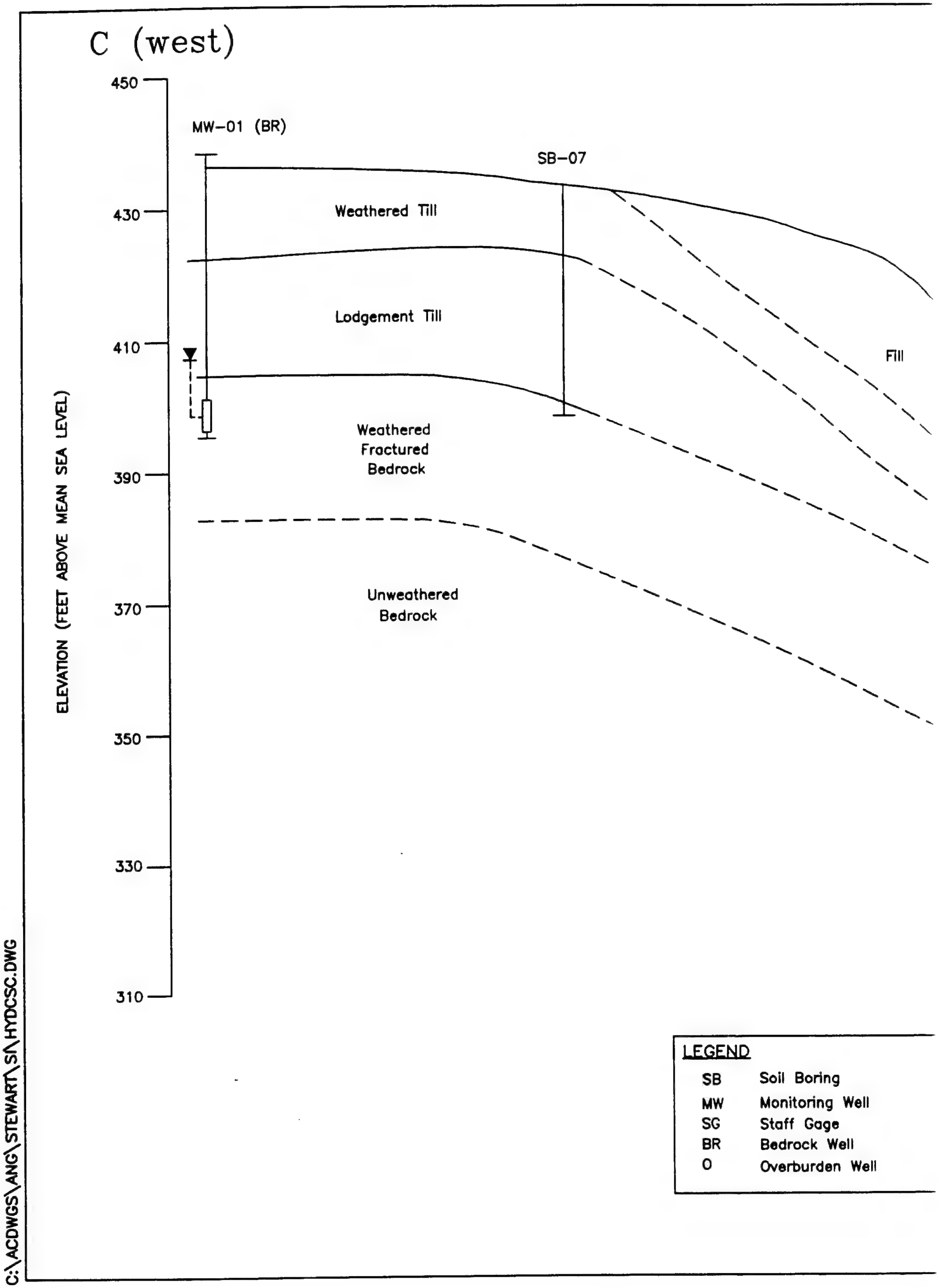
PROJECT MNGR m.P.	5/2/97

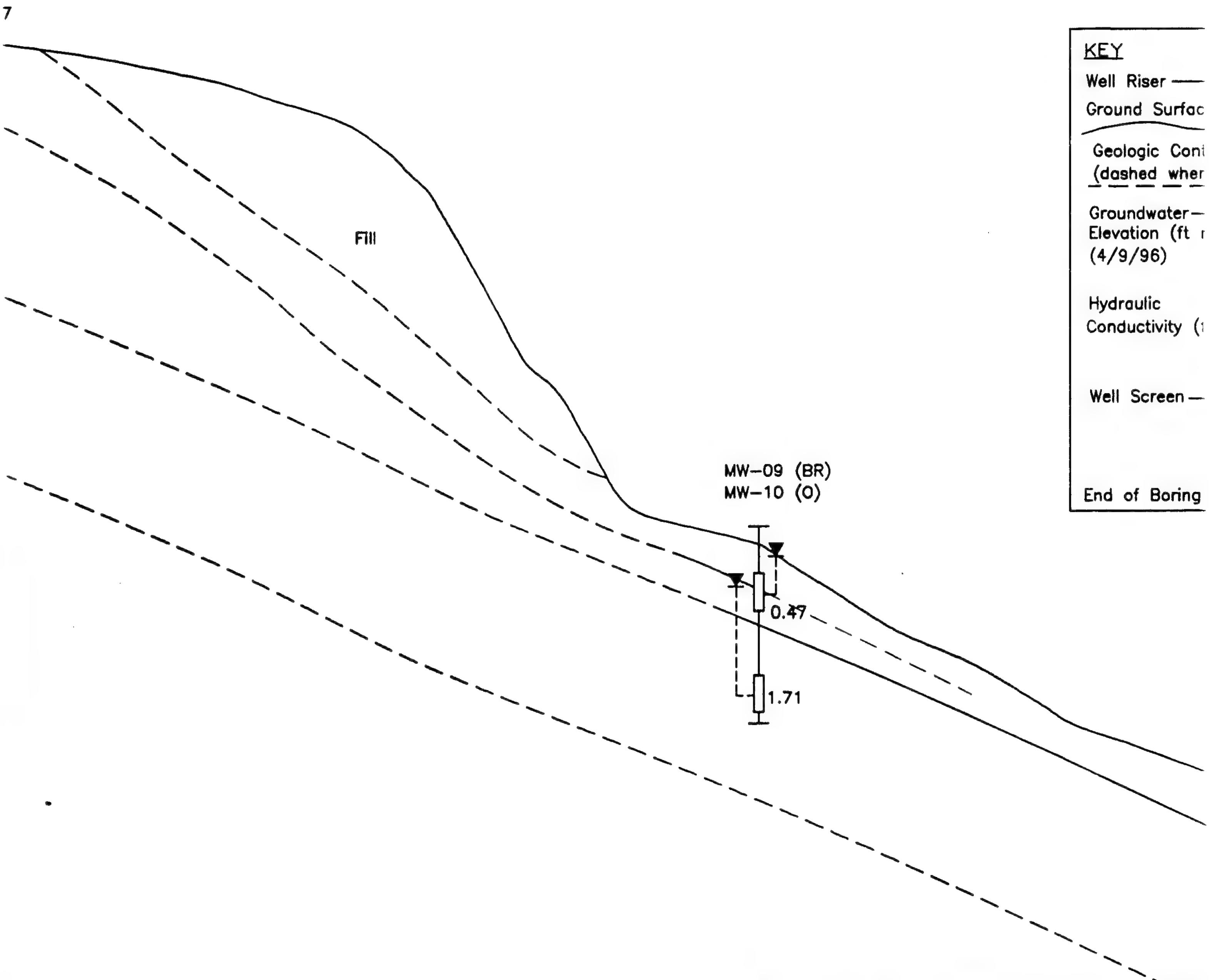
TITLE
FIGURE 5-3
HYDROGEOLOGIC CROSS SECTION B – B'
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: HORIZONTAL: 1 IN. = 100 FT. VERTICAL: 1 IN. = 10 FT.
DATE: APRIL 15, 1997	JOB NO.
SOURCE	SHEET 1 OF 1

3



C (west)
ELEVATION (FEET ABOVE MEAN SEA LEVEL)
450
430
410
390
370
350
330
310
MW-01 (BR)
SB-07
Weathered Till
Lodgement Till
Fill
Weathered
Fractured
Bedrock
Unweathered
Bedrock
LEGEND
SB Soil Boring
MW Monitoring Well
SG Staff Gage
BR Bedrock Well
O Overburden Well
C:\ACDWGS\ANG\STEWART\SI\HYDCSC.DWG



KEY

Well Riser —

Ground Surfac

Geologic Cont
(dashed wher

Groundwater —
Elevation (ft
(4/9/96)

Hydraulic
Conductivity (

Well Screen —

End of Boring

LEGEND

SB	Soil Boring
MW	Monitoring Well
SG	Staff Gage
BR	Bedrock Well
O	Overburden Well

SCALE

Horizontal
0 100 FT.
0 20 FT.
Vertical

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TECH. REVIEW	
PROJECT MNGR m.p.	5/2/97

TITLE
FIGUR
HYDROGEOLOGIC CR

STEWART AIR NA
NEWBURGH,

PREPARED FOR
NATIONAL GUARD
BUREAU

DATE
APRIL 15, 1997

SOURCE

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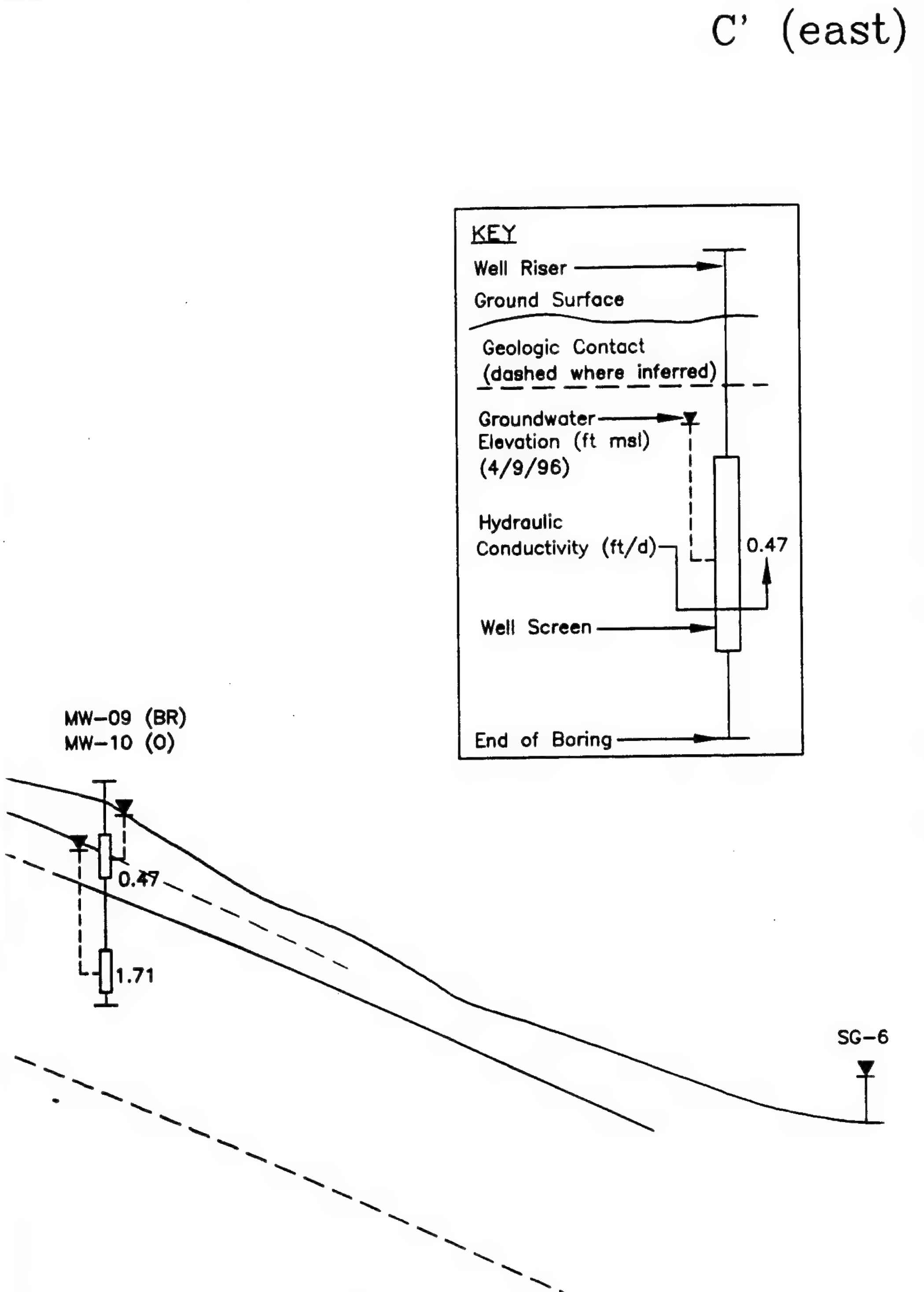

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209 West Central Street, Natick, MA 01760

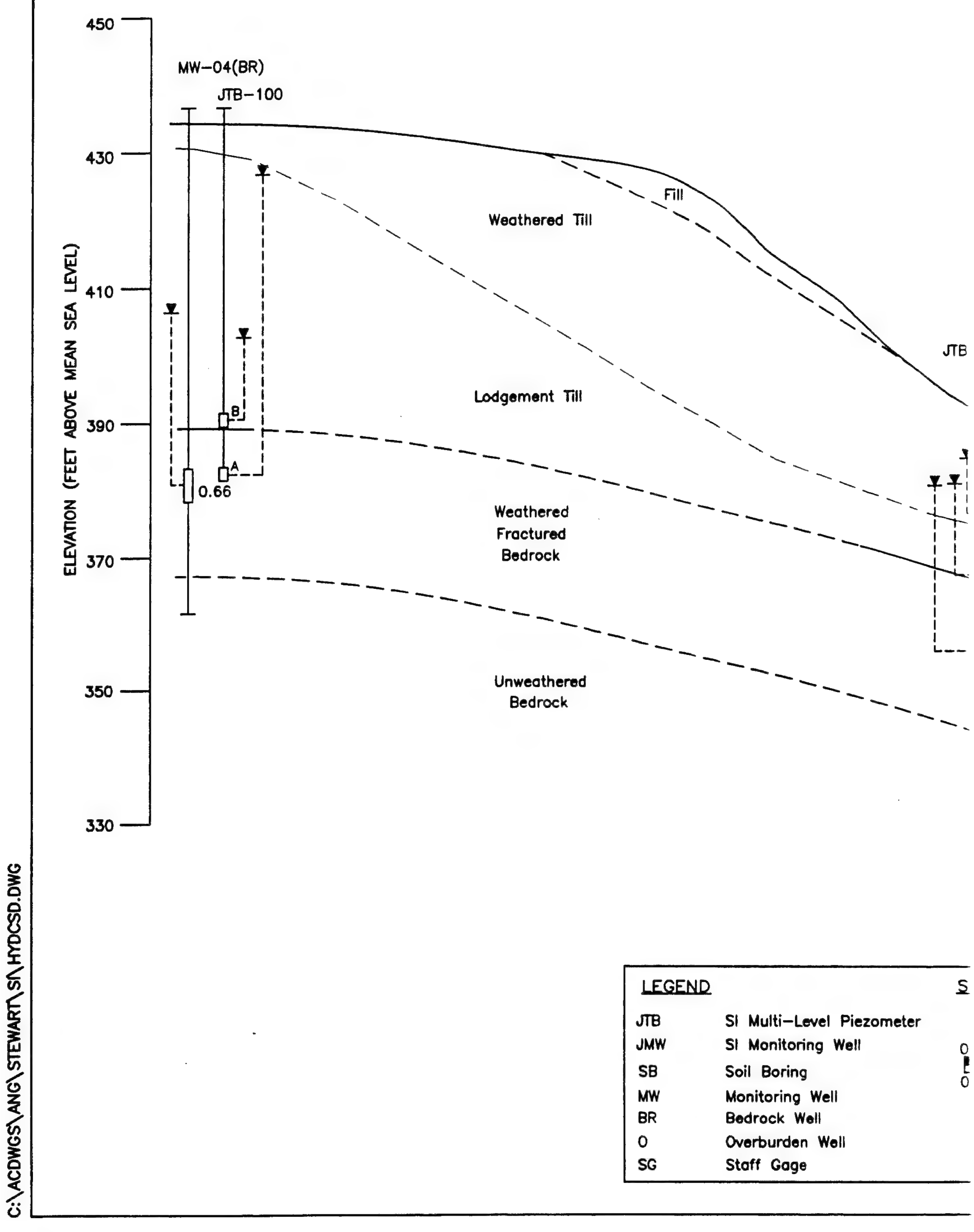
APPROVALS	DATE
DRAWN BLS	5/2/97
CHECKED	
QA/CONTROL	
TECH. REVIEW	
PROJECT MNGR m.p.	5/2/97

TITLE
FIGURE 5-4
HYDROGEOLOGIC CROSS SECTION C – C'
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

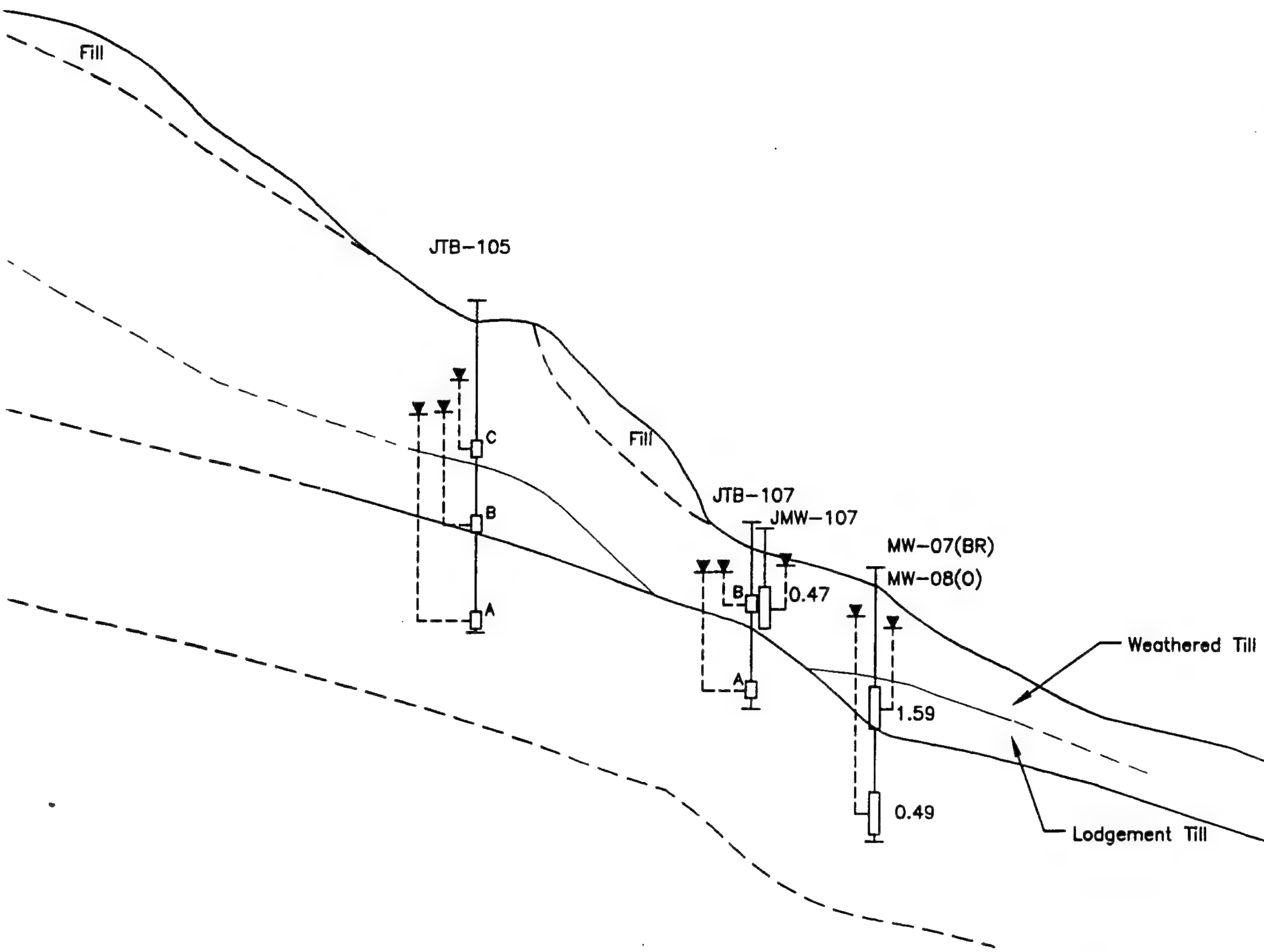
PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: HORIZONTAL: 1 IN. = 100 FT. VERTICAL: 1 IN. = 20 FT.
DATE: APRIL 15, 1997	JOB NO.
SOURCE	SHEET 1 OF 1

3

D (west)



LEGEND	
JTB	SI Multi-Level Piezometer
JMW	SI Monitoring Well
SB	Soil Boring
MW	Monitoring Well
BR	Bedrock Well
O	Overburden Well
SG	Staff Gage



KEY

Well F

Groun

Geolo.
(dash

Grour
Elevat
(4/9,

Hydrc
Condu

Well S

End o

LEGEND

JTB	SI Multi-Level Piezometer
JMW	SI Monitoring Well
SB	Soil Boring
MW	Monitoring Well
BR	Bedrock Well
O	Overburden Well
SG	Staff Gage

SCALE

Horizontal
0 — 100 FT.
0 — 20 FT.
Vertical

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TECH. REVIEW	
PROJECT MNGR m. P.	5/2/97

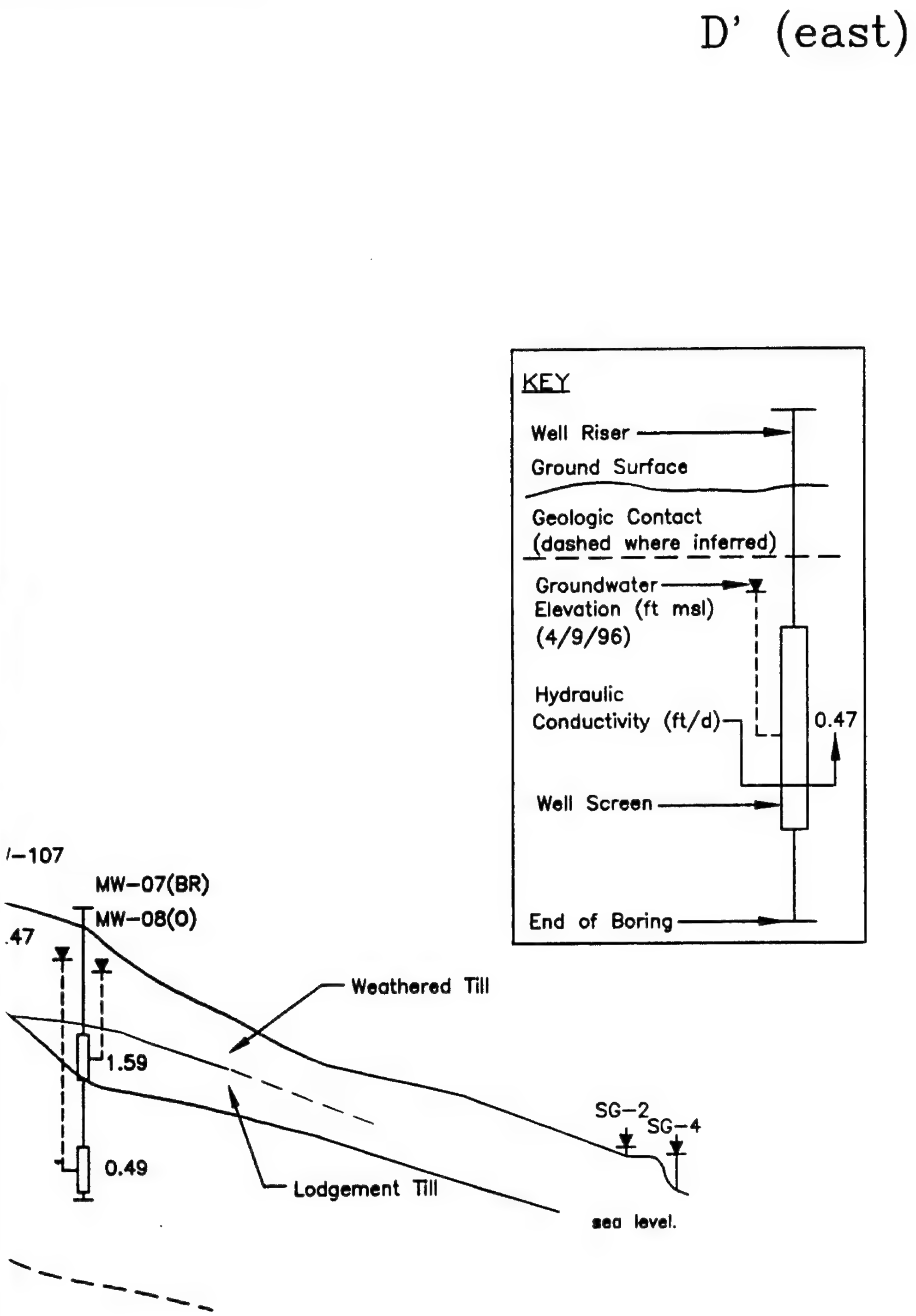
TITLE
FIGURE
HYDROGEOLOGIC CR
STEWART AIR NA
NEWBURGH,

PREPARED FOR
NATIONAL GUARD BUREAU

DATE
APRIL 15, 1997

SOURCE

2



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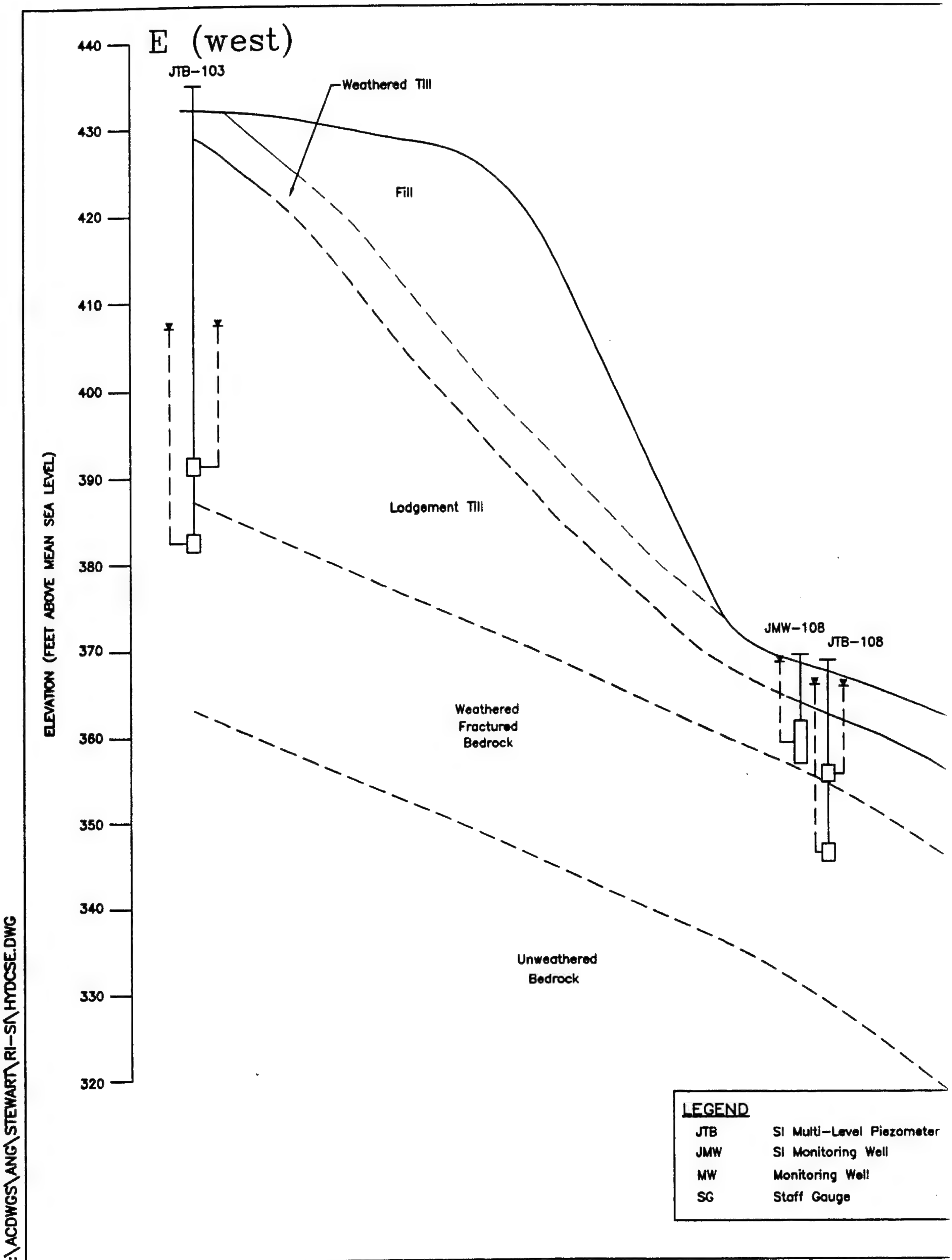
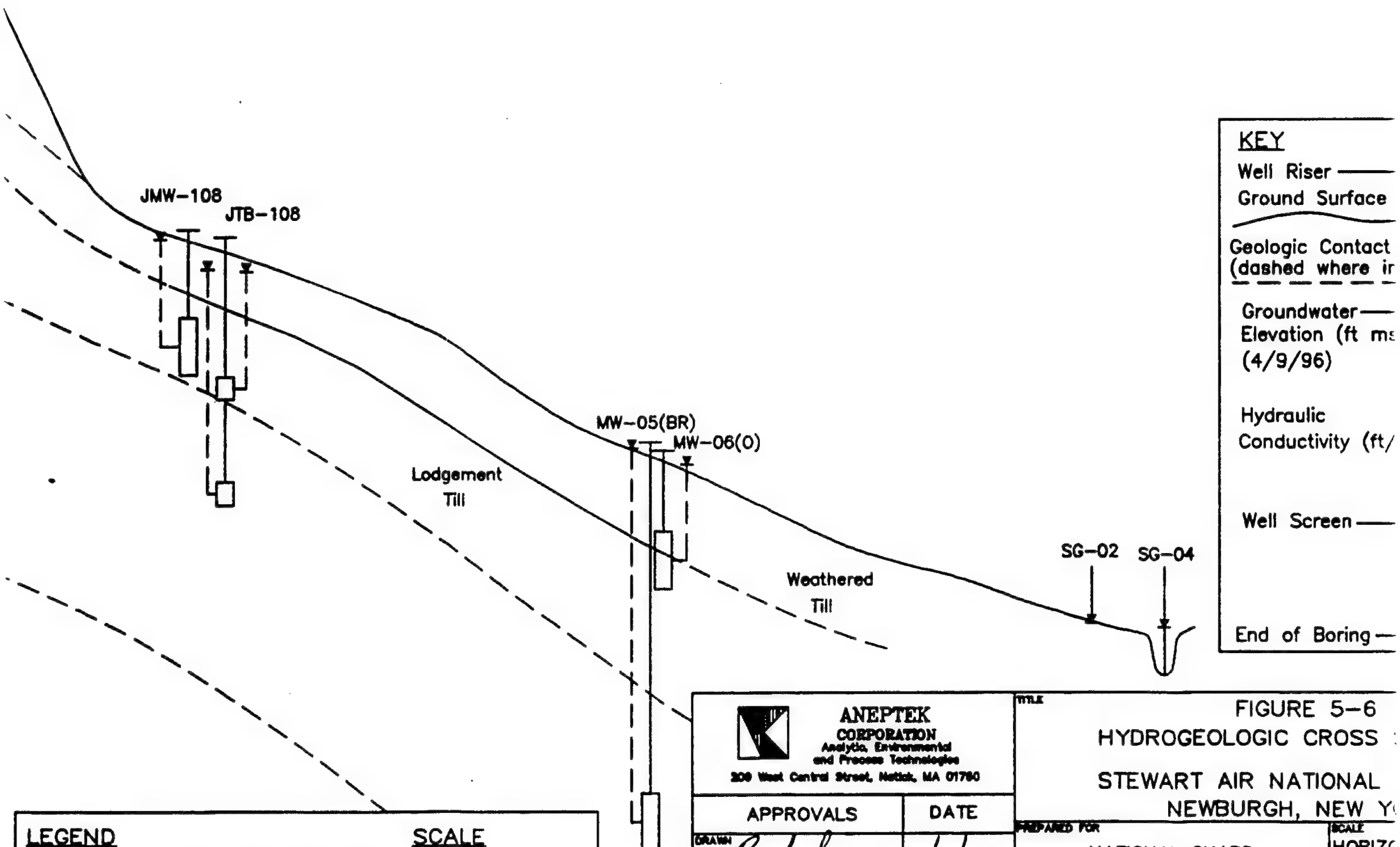
m. T.	5/2/97

TITLE
FIGURE 5–5
HYDROGEOLOGIC CROSS SECTION D – D'
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR	SCALE
NATIONAL GUARD BUREAU	HORIZONTAL: 1 IN. = 100 FT. VERTICAL: 1 IN. = 20 FT.
DATE: APRIL 15, 1997	JOB NO.
SOURCE	SHEET 1 OF 1

3


E (west)
JTB-103
Weathered Till
Fill
Lodgement Till
Weathered Fractured Bedrock
Unweathered Bedrock
JMW-108
JTB-108
ELEVATION (FEET ABOVE MEAN SEA LEVEL)
440
430
420
410
400
390
380
370
360
350
340
330
320
LEGEND
JTB SI Multi-Level Piezometer
JMW SI Monitoring Well
MW Monitoring Well
SG Staff Gauge
C:\ACDWGS\ANG\STEWART\RI-SI\HYDCSE.DWG



LEGEND

JTB	SI Multi-Level Piezometer
JMW	SI Monitoring Well
MW	Monitoring Well
SG	Staff Gauge

SCALE

Horizontal 0 — 90 FT.

0 — 15 FT. Vertical

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FIGURE 5-6
HYDROGEOLOGIC CROSS

STEWART AIR NATIONAL
NEWBURGH, NEW Y

APPROVALS	DATE
DRAWN BDA	5/2/97
CHECKED	
QA/CONTROL	
TECH. REVIEW	
PROJECT MNGR m.P.	5/2/97

PREPARED FOR: NATIONAL GUARD BUREAU

SCALE: HORIZ / VERTIC

DATE: APRIL 15, 1997

JOB NO.

SOURCE

SHEET

2

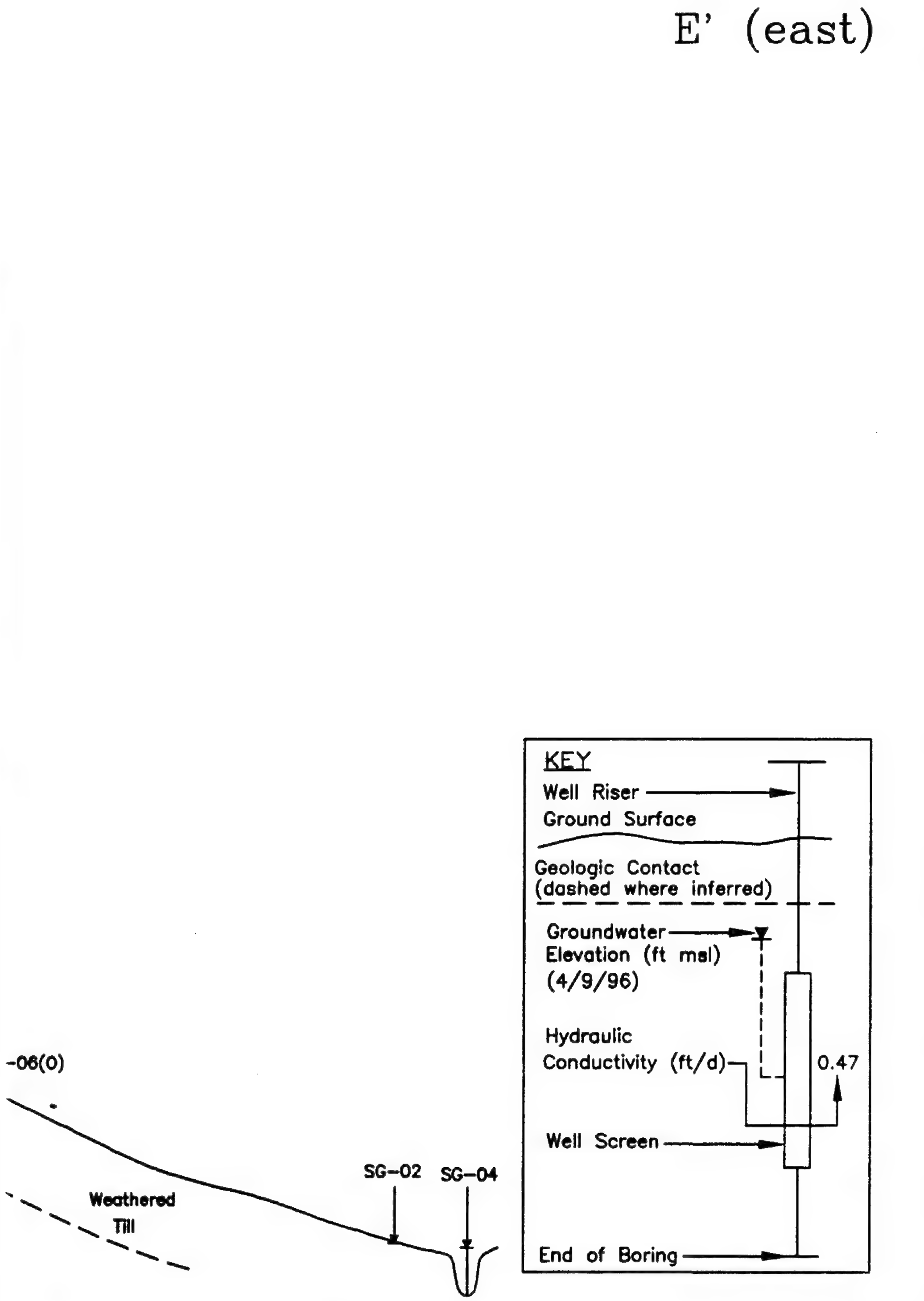

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FIGURE 5-6
HYDROGEOLOGIC CROSS SECTION E-E'

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

APPROVALS	DATE
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CHECKED	
QA/CONTROL	
TECH. REVIEW	
PROJECT MNGR m.P.	5/2/97

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: HORIZONTAL: 1 IN. = 50 FT. VERTICAL: 1 IN. = 10 FT.
DATE: APRIL 15, 1997	JOB NO.
SOURCE	SHEET 1 OF 1

3

transition completely to weathered till near the surface, beneath the wetlands at lower elevations, although no borings were advanced in this area.

Overlying the lodgement till is an interval of weathered till generally described as brown, medium dense to dense, poorly sorted, well graded clay and silt, some to little fine to medium, subangular to angular gravel, and little to no sand. The weathered till is much less dense than the lodgement till. The boundary between the weathered and unweathered till is observed between 4 to 18 feet bgs. The contact is generally indicated by both the color change, which defines the contact between aerobic and anaerobic soil zones and a sharp increase in blow counts and/or auger/split spoon refusal.

5.1.1.2 Bedrock Geology

The lithology and character of bedrock observed during the CI are consistent with descriptions from previous investigations performed by E.C. Jordan (E.C. Jordan, 1989).

Bedrock in the immediate vicinity west of Site 1 is encountered at depths of approximately 30 to 43.5 feet bgs (see Figures 5-2 and 5-4). Bedrock in this area is composed of fractured and weathered, soft, dark grey shale. Tight to open planar fractures were generally observed to be parallel to the bedding planes with a dip orientation of approximately 40 to 45 degrees from vertical. At most locations iron staining (goethite) was observed within fractures, indicating the flow of oxygenated groundwater. Occasional subvertical tight to open non-planar joints were also observed in some cores.

MW-04 was advanced to 67 feet bgs (28 feet into bedrock) in order to evaluate the extent of the weathered fractured shale zone contributing to groundwater flow. The observed fractures at a depth of 67 feet bgs in MW-04 appeared to be induced by the coring process, based on the close fit of core pieces and the lack of iron staining which indicated a fresh fracture surface.

Based on the MW-04 core, the weathered fractured shale zone is estimated to be approximately 22 feet. This thickness is greater than the maximum thickness of 10 feet initially reported by Dames and Moore (1986) and subsequently reported by E.C. Jordan (1989). Although the thickness of the weathered fractured shale bedrock zone contributing to flow is likely to vary through the study area, for the purposes of this investigation, the 22-foot thickness is assumed to be constant for calculation purposes.

Elevation calculations for the overburden/bedrock contact are provided on Table 5-1 and are shown on Figure 5-7. Figure 5-7 summarizes significant lithologic and structural interpretations from SI and RI core data. Figure 5-7 shows that bedrock slopes to the east, with a maximum elevation of approximately 400 feet msl in the vicinity of Site 2. Also noted on Figure 5-7 are indications of a high degree of fracturing (the retrieved core was basically weathered rubble with a low rock quality designation (RQD)) denoted with an "F", the presence of slickensides ("S") and the presence of calcite veins and lenses ("C") in the rock matrix. Of

TABLE 5-1
TOP OF BEDROCK ELEVATION SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

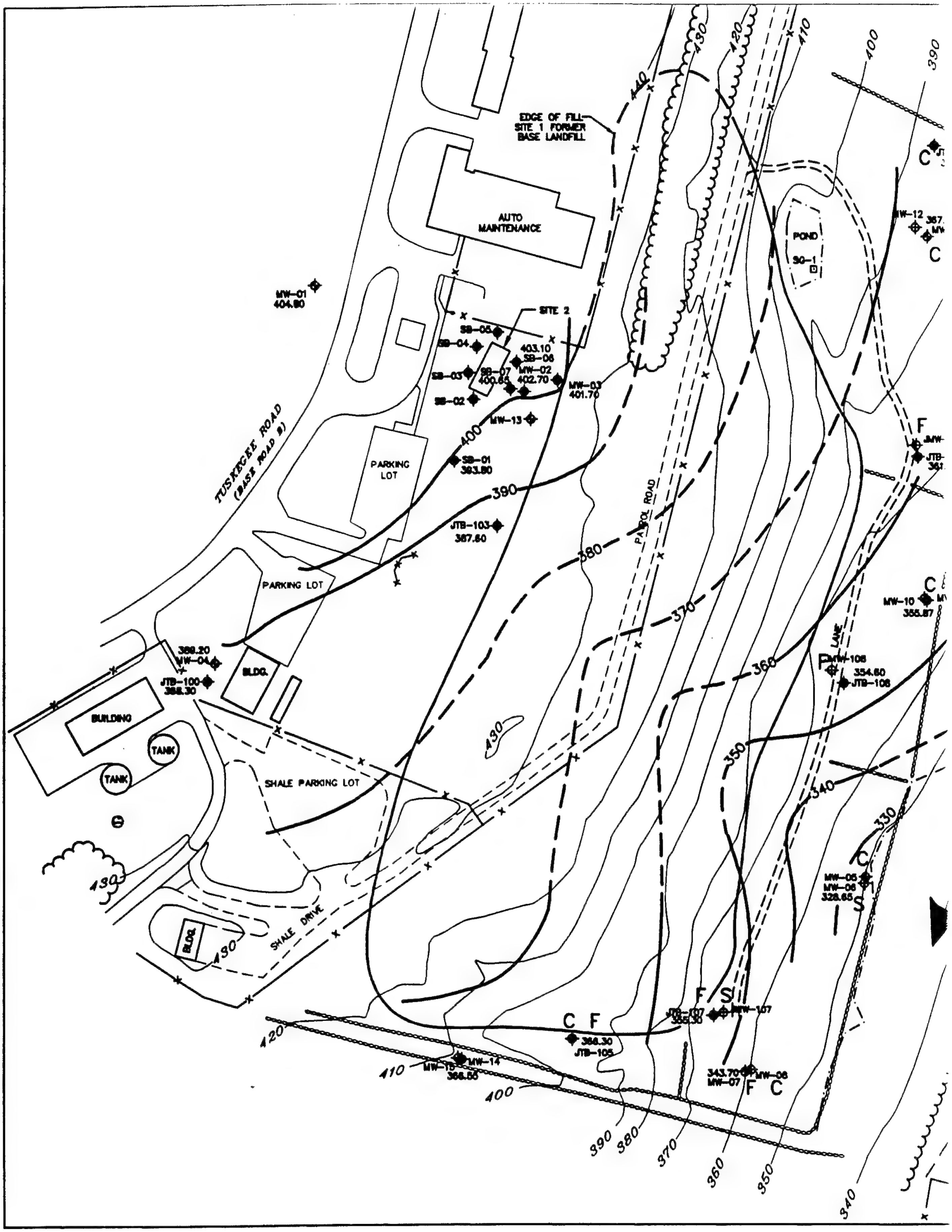
LOCATION	GROUND SURFACE ELEVATION (ft msl)	DEPTH TO BEDROCK (ft bgs)	BEDROCK ELEVATION (ft msl)
MW-01	436.40	31.6	404.80
MW-02	432.90	30.2	402.70
MW-03	433.70	32.0	401.70
MW-04	434.20	45.0	389.20
MW-05	349.90	21.3	328.60
MW-07	360.10	16.4	343.70
MW-09	366.20	10.3	355.90
MW-11	385.90	18.0	367.90
MW-14	408.80	42.3	366.50
JTB-100	433.90	45.6	388.30
JTB-103	432.60	45.0	387.60
JTB-105	391.80	25.5	366.30
JTB-106	386.80	19.6	367.20
JTB-107	364.70	9.4	355.30
JTB-108	367.40	12.8	354.60
JTB-109	371.60	10.4	361.20
SB-01	433.80	40.0	393.80
SB-06	434.60	31.5	403.10
SB-07	433.40	32.8	400.65

ABBREVIATIONS

ft - feet

bgs - below ground surface

msl - mean sea level



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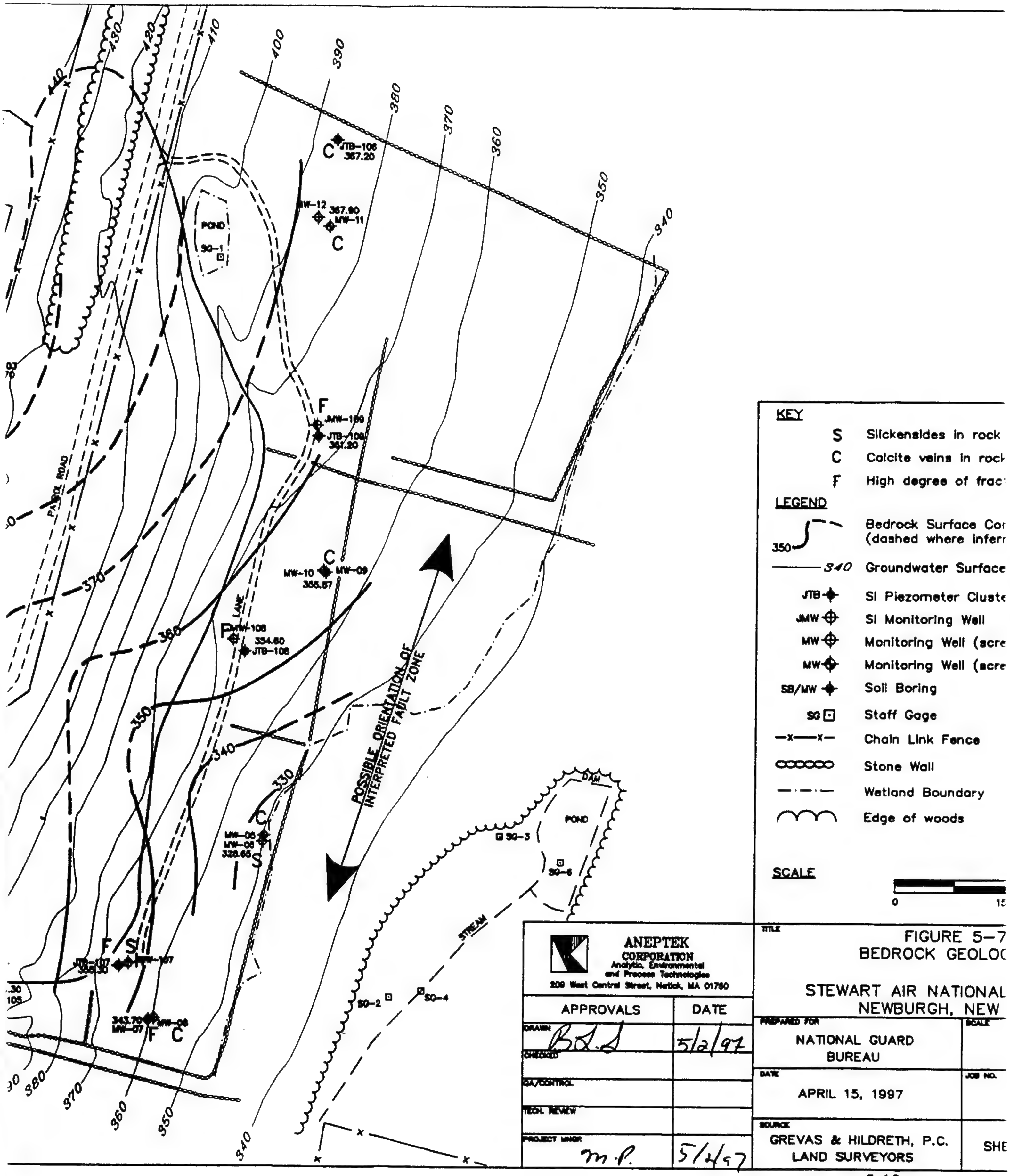

KEY
S Slickensides in rock
C Calcite veins in rock
F High degree of frac
LEGEND
350 Bedrock Surface Co
(dashed where inferr
340 Groundwater Surface
JTB SI Piezometer Cluste
JMW SI Monitoring Well
MW Monitoring Well (scre
MW Monitoring Well (scre
SB/MW Soil Boring
SG Staff Gage
Chain Link Fence
Stone Wall
Wetland Boundary
Edge of woods
SCALE
0
15
POSSIBLE ORIENTATION OF INTERPRETED FAULT ZONE
PATROL ROAD
LANE
POND
DAM
STREAM
JTB-106 367.20
MW-12 367.90
MW-11
SG-1
JMW-109
JTB-109
MW-10
MW-09
355.87
JMW-108
354.60
JTB-108
MW-05
MW-06
328.65
SG-3
SG-6
SG-2
SG-4
JTB-107
MW-107
343.70
MW-07
MW-08
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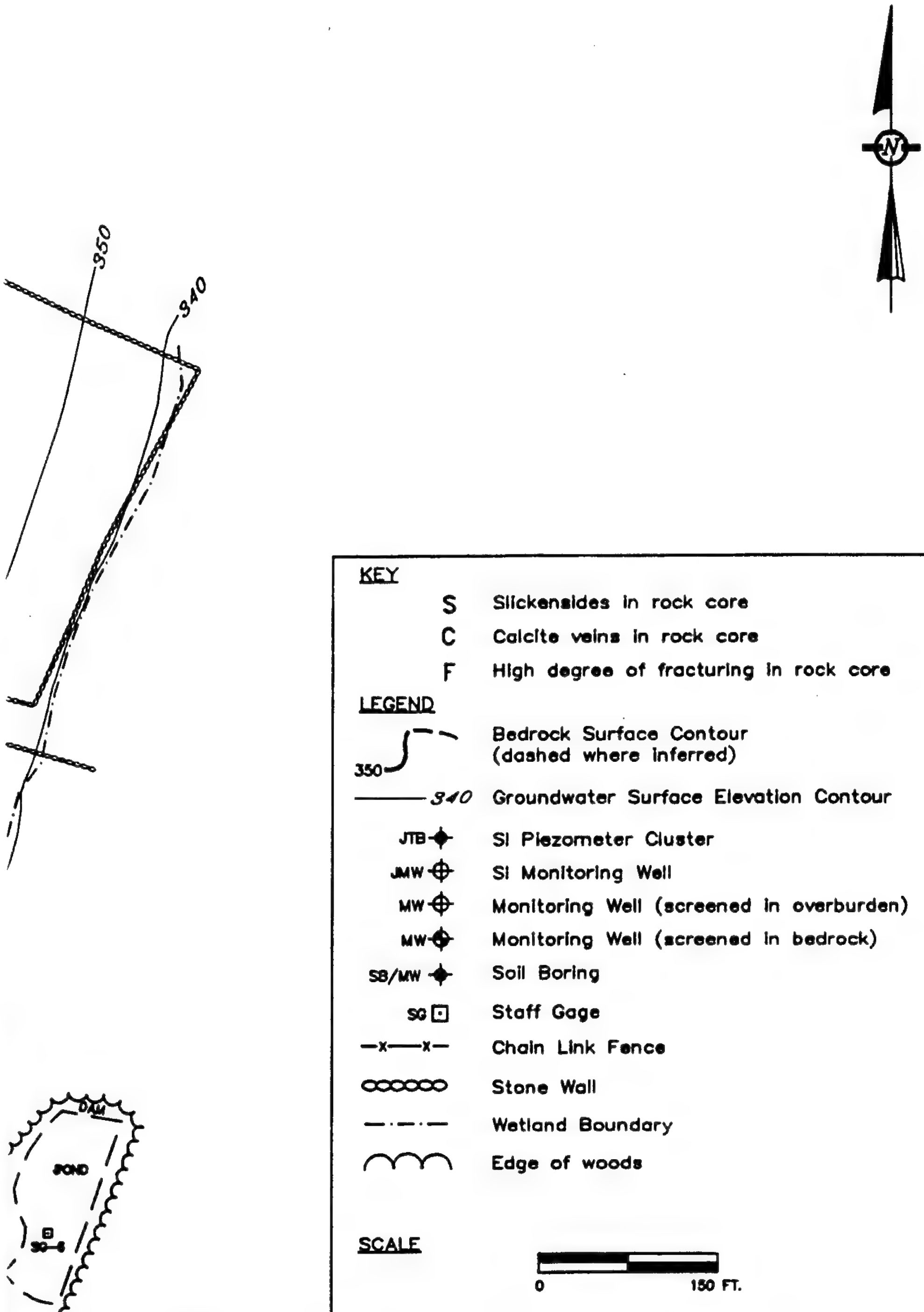
PROJECT MNGR
M.P.
5/2/97
TITLE
FIGURE 5-7
BEDROCK GEOLOC
STEWART AIR NATIONAL
NEWBURGH, NEW
PREPARED FOR
NATIONAL GUARD
BUREAU
SCALE
DATE
APRIL 15, 1997
JOB NO.
SOURCE
GREVAS & HILDRETH, P.C.
LAND SURVEYORS
SHE

2



KEY

- **S** Slickensides in rock core
- **C** Calcite veins in rock core
- **F** High degree of fracturing in rock core

LEGEND

- 350 Bedrock Surface Contour (dashed where inferred)
- 340 Groundwater Surface Elevation Contour
- JTB SI Piezometer Cluster
- JMW SI Monitoring Well
- MW Monitoring Well (screened in overburden)
- MW Monitoring Well (screened in bedrock)
- SB/MW Soil Boring
- SG Staff Gage
- —x—x— Chain Link Fence
- Stone Wall
- Wetland Boundary
- Edge of woods

SCALE

0 150 FT.

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760

TITLE
FIGURE 5–7
BEDROCK GEOLOGY MAP

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

APPROVALS	DATE
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CHECKED	
QA/CONTROL	
TECH. REVIEW	
PROJECT MANAGER m.P.	5/2/97

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 15, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

3

interest is the distribution of bedrock where significant secondary calcite veins are observed. These cores were primarily found on the eastern side of the study area. Fractures with slickensides and highly fractured cores appear to be confined to this area as well. The change in lithology and structural data indicate that a fault zone may exist east of Site 1. The potential orientation of this zone is illustrated by the arrow on Figure 5-7.

The probable presence of a fault is also indicated by larger scale lineaments indicated by topography. Figure 5-8 is derived from the United States Geological Survey (USGS) quadrangle maps that encompass the study area. Superimposed on this map is a rectangle encompassing the original topography of the eastern area of the Base obtained from the Base grading plans (USACE, 1943). Lineaments observed on the USGS topographic map are marked in black. A lineament identified in the original topography is bracketed by two arrow heads. The figure shows that the north-northeast trending lineament observed in the original topography appears to be an extension of a lineament on the east side of a drumlin to the northeast of the Base. These lineaments support the interpretation that a fracture zone or fault is present in the vicinity of the study area.

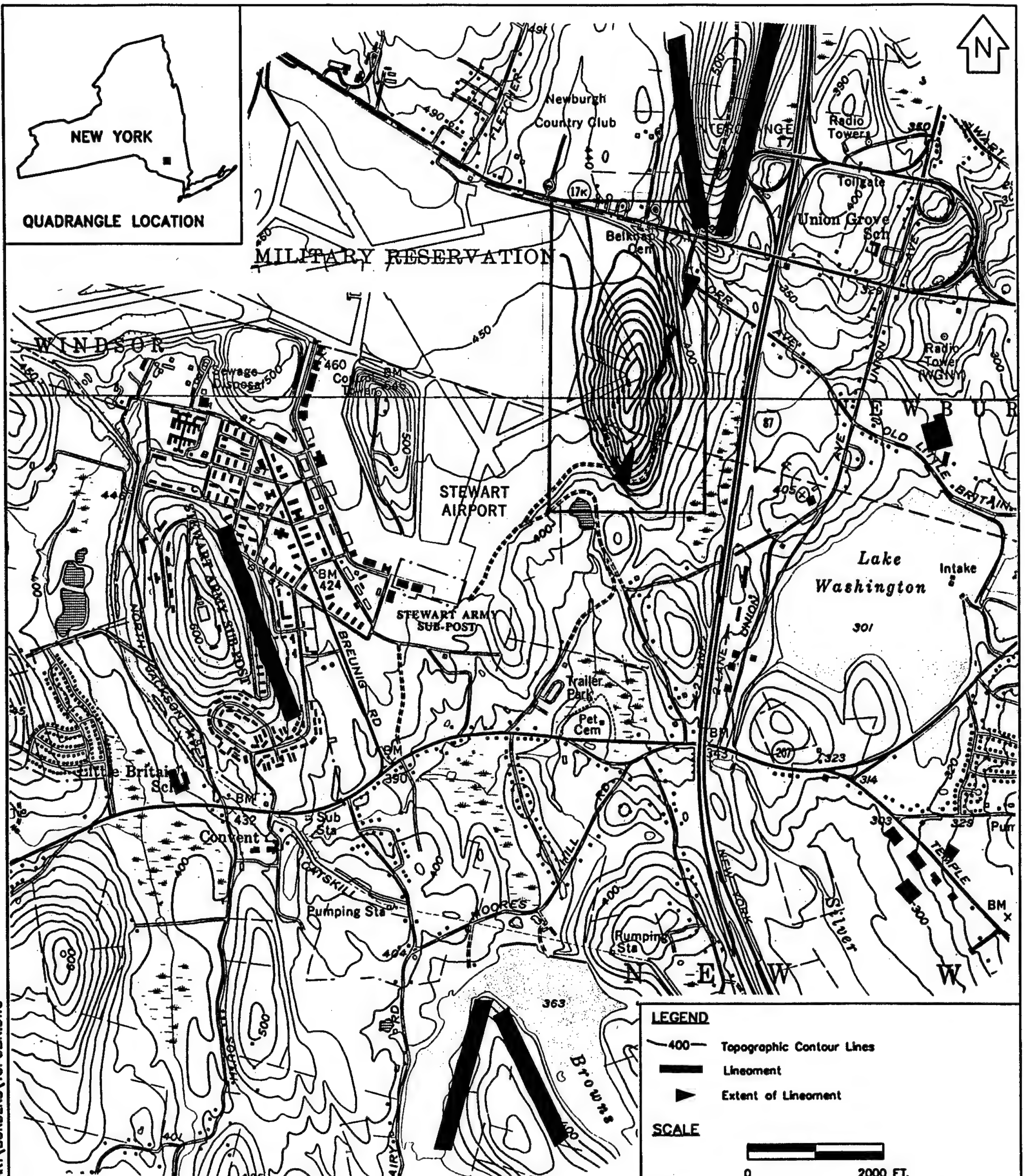
5.1.2 Hydrogeology

This section presents and summarizes the basic hydrologic properties of the groundwater flow system in the study area. The evaluation of site hydrogeology included: (1) the distribution of hydraulic head in both the bedrock and overburden aquifers based on measurements obtained during December 1995, March 1996, April 1996, August 1996; (2) calculation of vertical and horizontal hydraulic gradient; (3) estimation of effective porosity; (4) calculation of hydraulic conductivity; (5) calculation of average linear (seepage) velocity; and (6) surface water measurements.

Table 5-2 presents a summary of well construction information for all existing and newly installed wells in the study area that were utilized during this investigation. Piezometers and well clusters JTB-101/JMW-101 and JTB-104 installed during the SI were destroyed. In addition, JTB-102 could not be located during this investigation and is presumed destroyed. All water level data are summarized in Table 5-3. Supporting calculations are provided in Appendix F, Tables F-1 through F-3.

In general, groundwater flow in the study area can be separated into two interconnected flow systems: an upper flow system in the overburden, and a lower system in the underlying fractured bedrock. The hydrogeologic stratigraphy and piezometric data of the study area are illustrated in Figures 5-2 through 5-6. The figures illustrate that, in most cases, total head in piezometers or well clusters varies significantly between the overburden and bedrock stratigraphic units; therefore, vertical flow is an important component of the study area subsurface hydrology.

The lodgement till appears to be a low permeability unit, especially in the vicinity of Site 2 where the unweathered portion of the till is very thick (greater than 20 feet). Further to the east, beneath Site 1, the unweathered and weathered till are probably transmissive to some extent



PREPARED FOR		ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 W. Central Street, Natick, MA 01760	TITLE
NATIONAL GUARD BUREAU			FIGURE 5–8 TOPOGRAPHIC LINEAMENT ANALYSIS
DATE APRIL 16, 1997	SCALE 1 IN. = 2000 FT.		
SOURCE USGS, 1957			STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK

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TABLE 5-2
WELL CONSTRUCTION SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

WELL/ PIEZOMETER DESIGNATION	REFERENCE POINT	NORTHING	EASTING	GROUND SURFACE ELEVATION (ft msl)	REFERENCE POINT ELEVATION (ft msl)	RISER HEIGHT ABOVE GROUND SURFACE (ft)	DEPTH TO TOP OF SCREEN (ft bgs)	ELEVATION TOP OF SCREEN (ft msl)	DEPTH TO BOTTOM OF SCREEN (ft bgs)	ELEVATION BOTTOM OF SCREEN (ft msl)	ELEVATION CENTER OF SCREEN (ft msl)	TOTAL DEPTH OF BORING (ft bgs)[1]
MW-01	Top PVC	546067.50	568494.86	436.40	438.49	2.09	37.00	399.40	42.00	394.40	396.90	42.50
MW-04	Top PVC	545635.45	568377.81	434.20	436.29	2.09	51.00	383.20	56.00	378.20	380.70	72.50
MW-05	Top PVC	545386.81	569141.95	349.90	352.28	2.38	30.00	319.90	35.00	314.90	317.40	35.70
MW-06	Top PVC	545379.11	569140.65	347.90	352.53	4.63	5.00	342.90	10.00	337.90	340.40	10.40
MW-07	Top PVC	545159.95	568999.12	360.10	362.77	2.67	24.75	335.35	29.75	330.35	332.85	30.90
MW-08	Top PVC	545163.32	569006.95	359.40	362.14	2.74	11.30	348.10	16.30	343.10	345.60	16.80
MW-09	Top PVC	545707.49	569215.77	366.20	368.81	2.61	17.50	348.70	22.50	343.70	346.20	26.00
MW-10	Top PVC	545709.25	569212.22	366.20	368.39	2.19	4.00	362.20	9.00	357.20	359.70	9.50
MW-11	Top PVC	546123.29	569216.33	385.90	388.69	2.79	22.70	363.20	27.70	358.20	360.70	28.40
MW-12	Top PVC	546134.05	569201.45	387.20	389.78	2.58	5.00	382.20	10.00	377.20	379.70	11.00
MW-13	Top PVC	545914.49	568747.42	433.10	435.32	2.22	7.00	426.10	17.00	416.10	421.10	20.00
MW-14	Top PVC	568667.17	545175.11	408.80	411.57	2.77	53.27	358.30	58.27	353.20	355.80	57.00
MW-15	Top PVC	568662.61	545176.73	408.80	412.20	3.40	9.90	402.30	14.90	397.30	399.80	12.80
SW-2	Top Casing	545957.68	568735.43	433.80	435.58	1.78	40.00	393.80	50.00	383.80	388.80	50.00
SW-3	Top Casing	545965.67	568784.06	434.00	434.19	0.19	35.00	399.00	45.00	389.00	394.00	49.50
JMW-107	Top PVC	545229.41	568973.75	364.10	367.04	2.94	4.38	359.72	9.38	354.72	357.22	9.50
JMW-108	Top Casing	545625.69	569101.83	368.10	370.70	2.60	5.97	362.13	10.97	357.13	359.63	12.00
JMW-109	Top PVC	545885.15	569202.79	371.80	374.15	2.35	5.25	366.55	10.25	361.55	364.05	11.00
JTB-100 (a)	Top PVC	545614.25	568368.71	433.90	436.00	2.10	50.50	383.40	52.50	381.40	382.40	55.60
JTB-100 (b)	Top PVC	545614.25	568368.71	433.90	436.24	2.34	42.50	391.40	44.50	389.40	390.40	45.60
JTB-103(a)	Top Casing	545792.41	568708.36	432.60	435.53	2.93	49.30	383.30	51.30	381.30	382.30	51.40
JTB-103 (b)	Top Casing	545792.41	568708.36	432.60	435.53	2.93	39.90	392.70	41.90	390.70	391.70	44.00
JTB-105 (a)	Top Casing	545198.81	568795.85	391.80	394.43	2.63	34.60	357.20	36.60	355.20	356.20	38.00
JTB-105 (b)	Top Casing	545198.81	568795.85	391.80	394.43	2.63	23.10	368.70	25.10	366.70	367.70	26.30
JTB-105 (c)	Top Casing	545198.81	568795.85	391.80	394.43	2.63	14.10	377.70	16.10	375.70	376.70	17.20
JTB-106 (a)	Top Casing	546227.65	569224.44	386.80	389.85	3.05	25.80	361.00	27.80	359.00	360.00	30.00
JTB-106 (b)	Top Casing	546227.65	569224.44	386.80	389.85	3.05	16.80	370.00	18.80	368.00	369.00	19.50
JTB-107 (a)	Top Casing	545225.95	568692.27	364.70	367.92	3.22	15.90	348.80	17.90	346.80	347.80	19.40
JTB-107 (b)	Top Casing	545225.95	568692.27	364.70	367.92	3.22	5.50	359.20	7.50	357.20	358.20	8.00
JTB-108 (a)	Top Casing	545610.97	569116.04	367.40	370.31	2.91	19.60	347.80	21.60	345.80	346.80	22.80
JTB-108 (b)	Top Casing	545610.97	569116.04	367.40	370.31	2.91	10.60	356.80	12.60	354.80	355.80	14.80
JTB-109 (a)	Top Casing	545871.82	569204.75	371.60	373.96	2.36	17.30	354.30	19.30	352.30	353.30	19.40
JTB-109 (b)	Top Casing	545871.82	569204.75	371.60	373.96	2.36	7.70	363.90	9.70	361.90	362.90	13.00

NOTES

[1] Total depth of boring for multi-level piezometers indicate depth to bottom of boring for the (a) piezometer and the top of the bentonite seal between screens for other intervals.

bgs - below ground surface

ft - feet

msl - mean sea level

hydrogeo.xls

4/17/97

TABLE 5-3
GROUNDWATER ELEVATION SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

MEASUREMENT LOCATION	GROUNDWATER ELEVATION 12/8/95 (ft msl)	GROUNDWATER ELEVATION 3/19/96 (ft msl)	GROUNDWATER ELEVATION 4/9/96 (ft msl)	GROUNDWATER ELEVATION 8/15/96 (ft msl)
MW-01	406.81	407.39	407.37	407.76
MW-04	405.89	406.33	406.30	406.36
MW-05	349.17	350.39	350.24	348.08
MW-06	348.35	349.16	348.79	346.25
MW-07	355.00	356.97	356.70	354.2
MW-08	353.54	355.70	355.28	352.24
MW-09	357.64	361.09	360.52	358.01
MW-10	363.44	365.46	364.59	362.19
MW-11	371.95	374.51	374.09	369.5
MW-12	383.50	386.26	386.63	382.02
MW-13	423.12	423.94	423.67	422.57
MW-14	NM	NM	NM	382.54
MW-15	NM	NM	NM	398.06
SW-2	410.93	411.99	411.42	411.13
SW-3	410.76	411.64	411.48	410.74
JMW-107	NM	NM	362.77	361.4
JMW-108	367.73	368.62	368.46	367.32
JMW-109	370.45	371.37	371.33	368.25
JTB-100 (a)	424.39	NM	426.67	NM
JTB-100 (b)	407.73	NM	407.53	NM
JTB-103(a)	414.75	408.23	407.12	407.15
JTB-103 (b)	411.39	408.30	407.47	407.05
JTB-105 (a)	NM	NM	380.75	378.89
JTB-105 (b)	NM	NM	380.97	379.11
JTB-105 (c)	NM	NM	384.76	383.04
JTB-106 (a)	374.38	377.95	377.01	372.94
JTB-106 (b)	374.81	378.10	377.36	373.2
JTB-107 (a)	361.14	362.44	361.94	360.52
JTB-107 (b)	361.17	362.99	361.96	360.53
JTB-108 (a)	NM	NM	365.87	364.92
JTB-108 (b)	NM	NM	365.69	364.81
JTB-109 (a)	369.76	370.67	370.81	368.05
JTB-109 (b)	370.27	370.81	371.09	368.35
SG-01	390.31	NM	390.83	390.16
SG-02	334.95	NM	335.05	335.00
SG-03	333.82	NM	333.84	333.88
SG-04	334.15	NM	334.29	NM
SG-06	331.25	NM	332.57	331.91

ABBREVIATIONS

ft - feet

NM - not measured

msl - mean sea level

NOTES

Groundwater elevation calculations are found in Appendix F, Tables F-1 through F-3.

given the observed hydraulic conductivities in both formations (see Section 5.1.2.4).

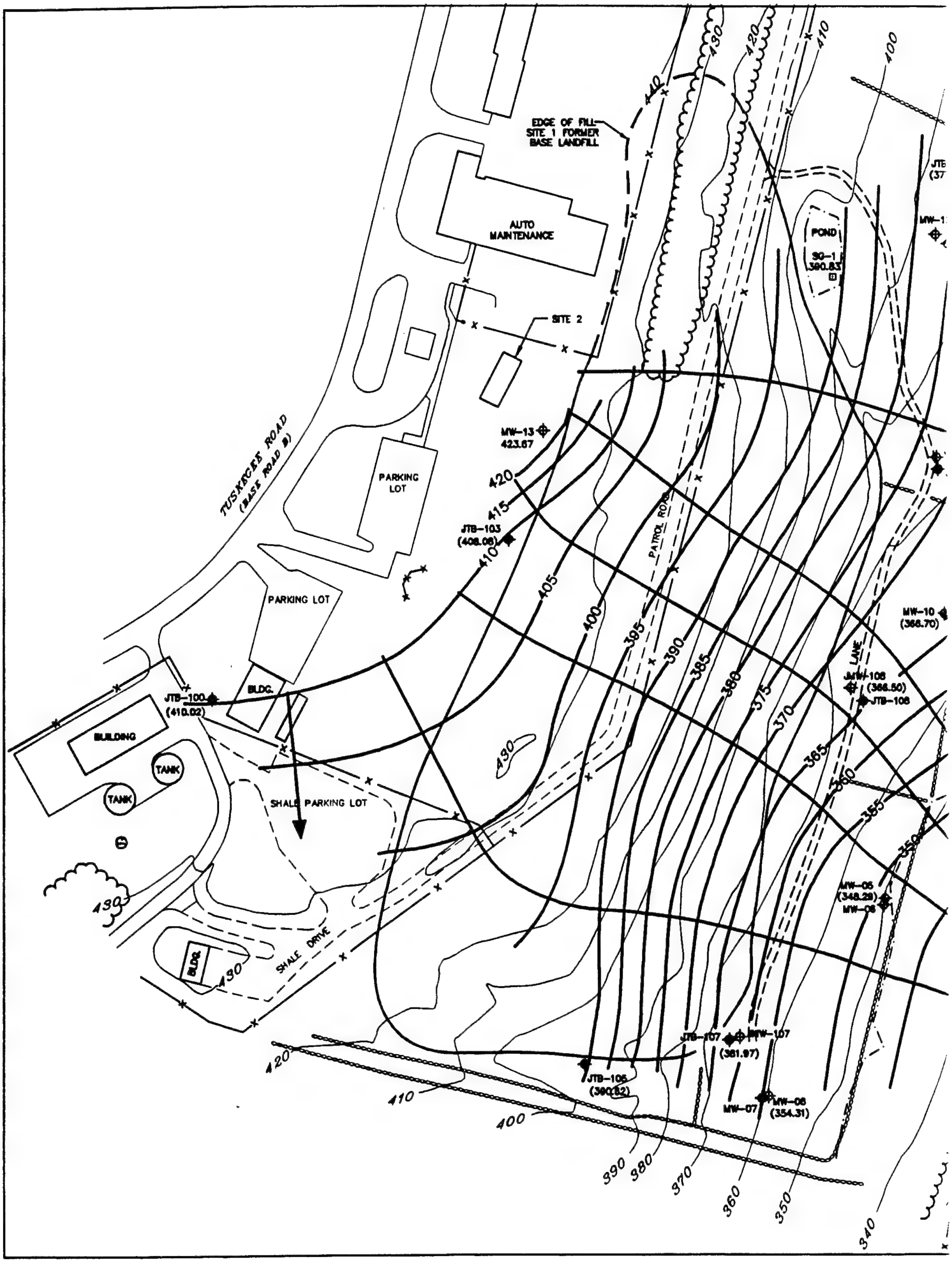
5.1.2.1 Horizontal Flow and Gradients

Of the four rounds of water level measurements collected (Table 5-3), two rounds were selected for contouring, the April 9, 1996 and August 15, 1996 data. These data were selected because they contained the most complete set of measurements. Water levels were not obtained from some of the monitoring wells and/or staff gages during the previous measurement rounds. Additionally, these two rounds reflect a high and a low seasonal groundwater condition. Figures 5-9 through 5-11 present the piezometric surface contours for the April and August water level measurement events. Figures 5-9 and 5-11 show the interpreted piezometric surface of the projected water table during April 9 and August 15, 1996, respectively. Figures 5-10 and 5-12 show the interpreted piezometric surface for monitoring wells installed in the shallow fractured bedrock during for the same dates.

In order to evaluate the connection between downgradient surface water bodies and the subsurface, Figures 5-9 and 5-11 show the projected water table instead of the piezometric surface of the deep overburden. This evaluation was performed because, given the substantial vertical gradients observed in the study area (see Section 5.1.2.2) and the fact that the deeper overburden wells were not all screened in the same depth interval, the head data from these wells did not represent the same portion of the aquifer. A description of the calculations used to determine the projected water table are presented in Appendix F. These calculations assume that vertical gradients are constant throughout the water column, which is reasonable for most well clusters in the study area. Exceptions are noted in the following discussion of vertical gradients.

Three significant interpretations are made. First, both the water table and bedrock groundwater contour maps show groundwater beneath Site 1 flows to the east or east-southeast towards the local topographic low at Murphy's Gulch. In the overburden, flow lines originating from the vicinity of Site 2 flow beneath Site 1 and terminate in the vicinity of Murphy's Gulch. A southeastern component of flow is interpreted in the bedrock in the southern portion of the study area, around wells JTB-105 and MW-14/15 that is not interpreted in the overburden. The data indicate that a component of flow in the bedrock that originates from Site 2 could flow to the southern portion of Site 1.

The second significant interpretation is the presence of a groundwater high in the bedrock in the vicinity of Site 2 west of Site 1. The current distribution of wells suggest that groundwater flows radially from Site 2. The bedrock piezometric high may be a purely local phenomenon caused by the presence of the former pesticide pit at Site 2. Site 2 lies in an area of lower surface relief in an open field. It is possible that the backfill in the pesticide burial area is not compacted as densely as the surrounding existing soils, thus possessing locally higher hydraulic conductivity and higher storage capacity than the surrounding till material into which the pit was excavated. Surface runoff entering this area could infiltrate more readily into the subsurface and be impeded from immediate further downward flow by the lower hydraulic conductivity natural



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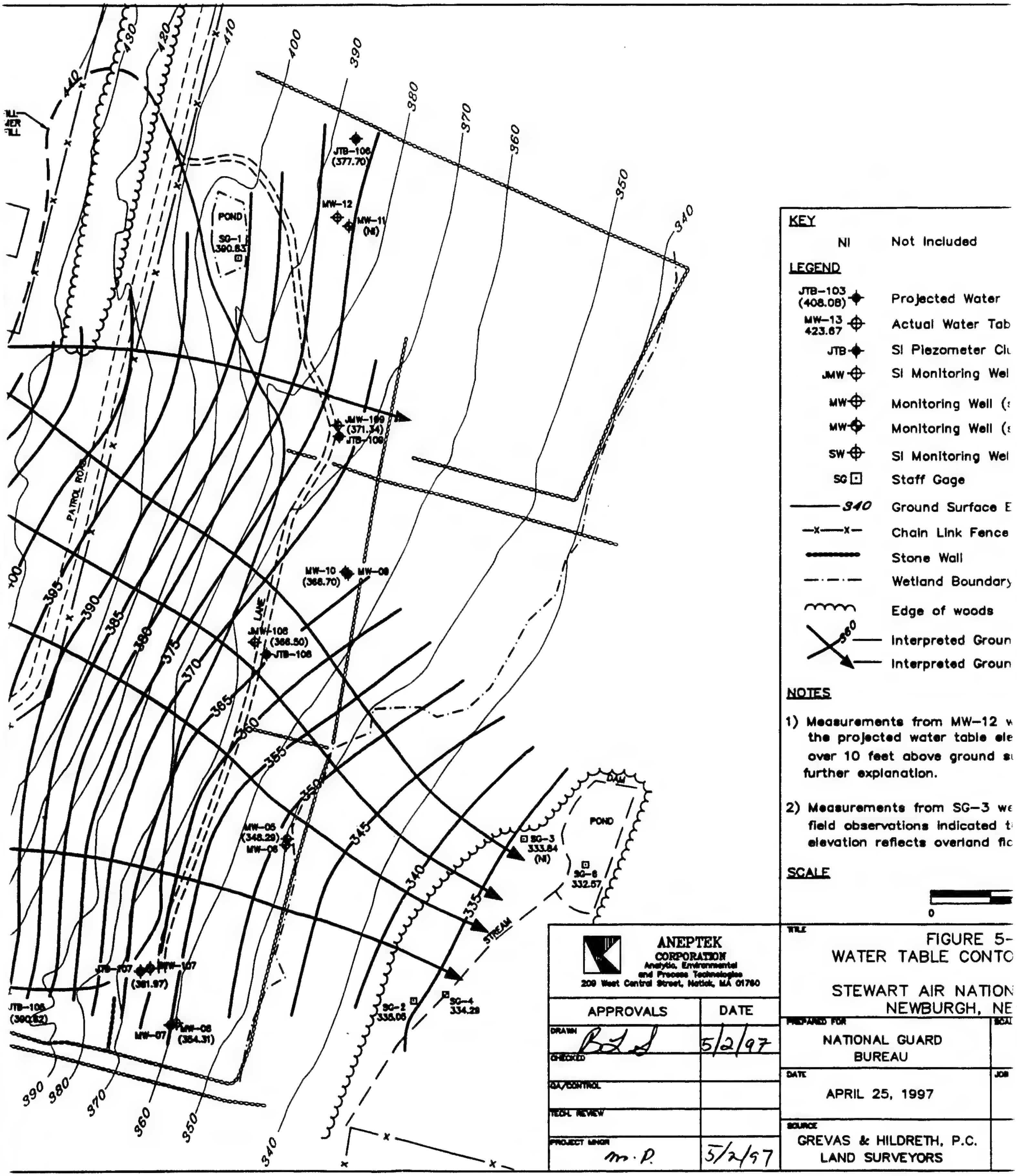
KEY
NI Not Included
LEGEND
JTB-103 (408.08) Projected Water
MW-13 423.67 Actual Water Tab
JTB SI Piezometer Clu
JMW SI Monitoring Wel
MW Monitoring Well (s
MW Monitoring Well (s
SW SI Monitoring Wel
SG Staff Gage
340 Ground Surface E
Chain Link Fence
Stone Wall
Wetland Boundary
Edge of woods
360 Interpreted Groun
Interpreted Groun
NOTES
1) Measurements from MW-12 w the projected water table ele over 10 feet above ground su further explanation.
2) Measurements from SG-3 we field observations indicated t elevation reflects overland flo
SCALE
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ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
APPROVALS
DATE
DRAWN
5/2/97
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TECH. REVIEW
PROJECT MNGR
m. P.
5/2/97
TITLE
FIGURE 5-
WATER TABLE CONTO
STEWART AIR NATION
NEWBURGH, NE
PREPARED FOR
NATIONAL GUARD BUREAU
DATE
APRIL 25, 1997
SOURCE
GREVAS & HILDRETH, P.C. LAND SURVEYORS
POND
SG-1 390.83
JTB-106 (377.70)
MW-12
MW-11 (NI)
JMW-109 (371.34)
JTB-109
MW-10 (368.70)
MW-09
JMW-108 (366.50)
JTB-108
PATROL ROAD
LANE
MW-05 (348.29)
MW-06
SG-3 333.84 (NI)
DAM
POND
SG-6 332.57
STREAM
JTB-107
JMW-107 (361.97)
JTB-105 (390.82)
MW-07
MW-08 (354.31)
SG-2 335.05
SG-4 334.29
440
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365
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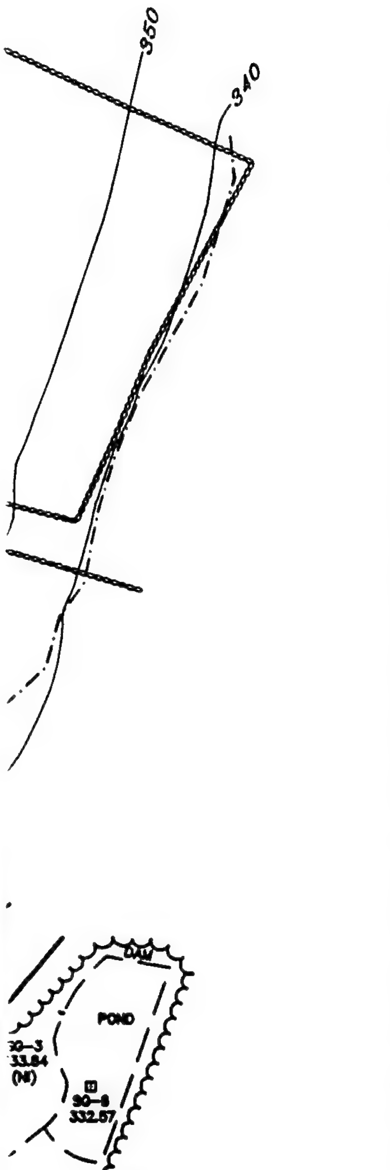
335

2



KEY

NI — Not Included

LEGEND

JTB-103 (408.08)	Projected Water Table Elevation
MW-13 423.67	Actual Water Table Elevation
JTB	SI Piezometer Cluster
JMW	SI Monitoring Well
MW	Monitoring Well (screened in overburden)
MW	Monitoring Well (screened in bedrock)
SW	SI Monitoring Well
SG	Staff Gage
340	Ground Surface Elevation Contour
—x—x—	Chain Link Fence
	Stone Wall
	Wetland Boundary
	Edge of woods
360	Interpreted Groundwater Elevation Contour
	Interpreted Groundwater Flow Line

NOTES

1) Measurements from MW-12 were not included because the projected water table elevation would have been over 10 feet above ground surface. See text for further explanation.

2) Measurements from SG-3 were not included because field observations indicated that the surface water elevation reflects overland flow, not aquifer conditions.

SCALE

0 — 150 FT.

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TITLE
FIGURE 5-9
WATER TABLE CONTOUR MAP 4/9/96
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

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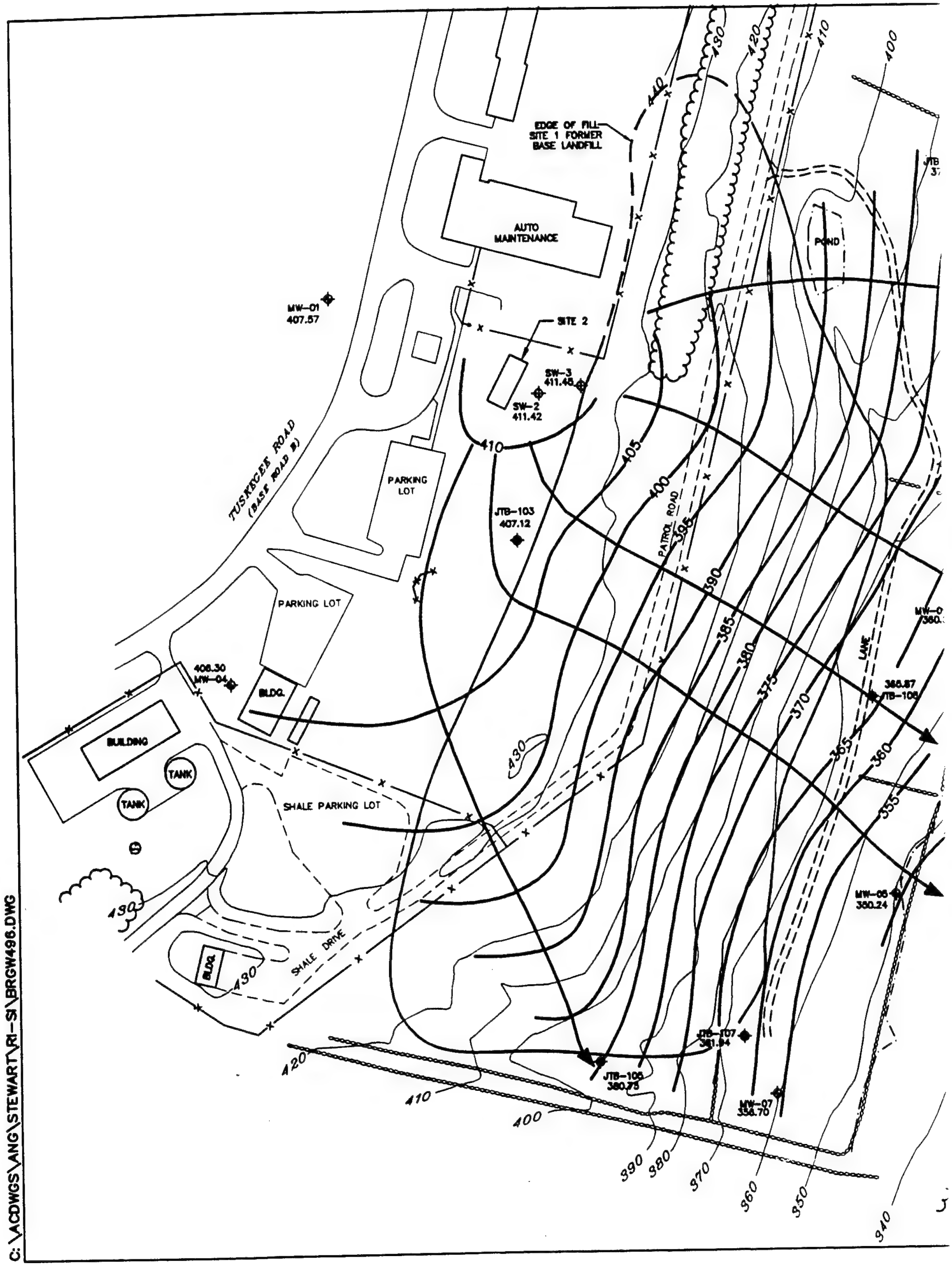
PROJECT MNGR m.P.	5/2/97

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 25, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

3


EDGE OF FILL
SITE 1 FORMER
BASE LANDFILL
AUTO MAINTENANCE
POND
MW-01
407.57
SITE 2
SW-3
411.45
SW-2
411.42
TUSKEGEE ROAD
(BASE ROAD B)
PARKING LOT
JTB-103
407.12
PATROL ROAD
PARKING LOT
408.30
MW-04
BLDG.
BUILDING
TANK
TANK
SHALE PARKING LOT
SHALE DRIVE
BLDG.
LANE
368.87
JTB-106
MW-05
360.24
JTB-107
381.94
JTB-105
380.75
MW-07
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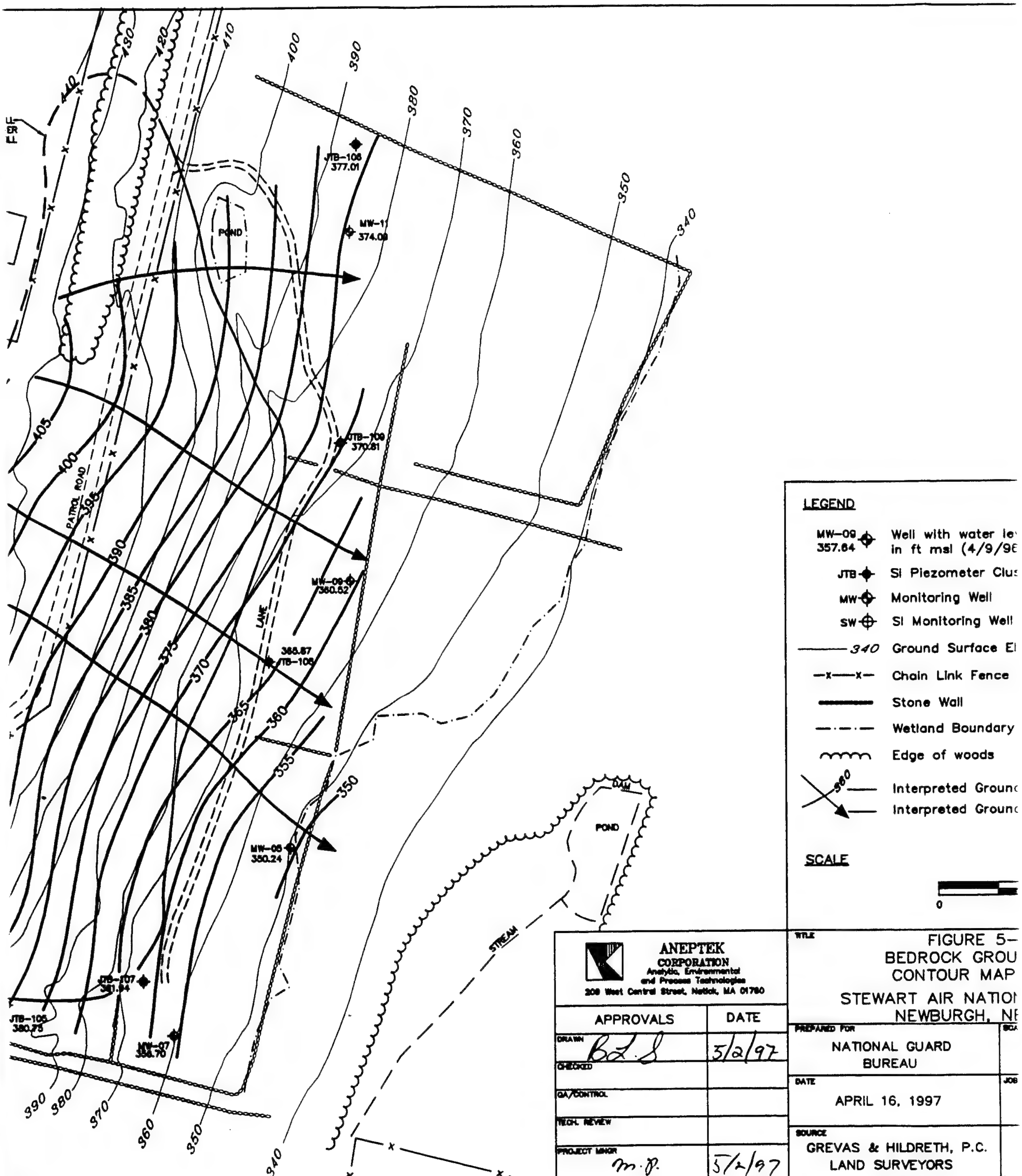
LEGEND
MW-09 357.64 Well with water le
in ft msl (4/9/96
JTB Sl Piezometer Clu
MW Monitoring Well
SW Sl Monitoring Well
340 Ground Surface El
Chain Link Fence
Stone Wall
Wetland Boundary
Edge of woods
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Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
APPROVALS
DATE
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PROJECT MNGR
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TITLE
FIGURE 5-
BEDROCK GROU
CONTOUR MAP
STEWART AIR NATIO
NEWBURGH, N
PREPARED FOR
NATIONAL GUARD
BUREAU
DATE
APRIL 16, 1997
SOURCE
GREVAS & HILDRETH, P.C.
LAND SURVEYORS
POND
JTB-108
377.01
MW-11
374.09
JTB-109
370.81
MW-09
360.52
385.87
JTB-106
MW-08
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JTB-105
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MW-07
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PATROL ROAD
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STREAM
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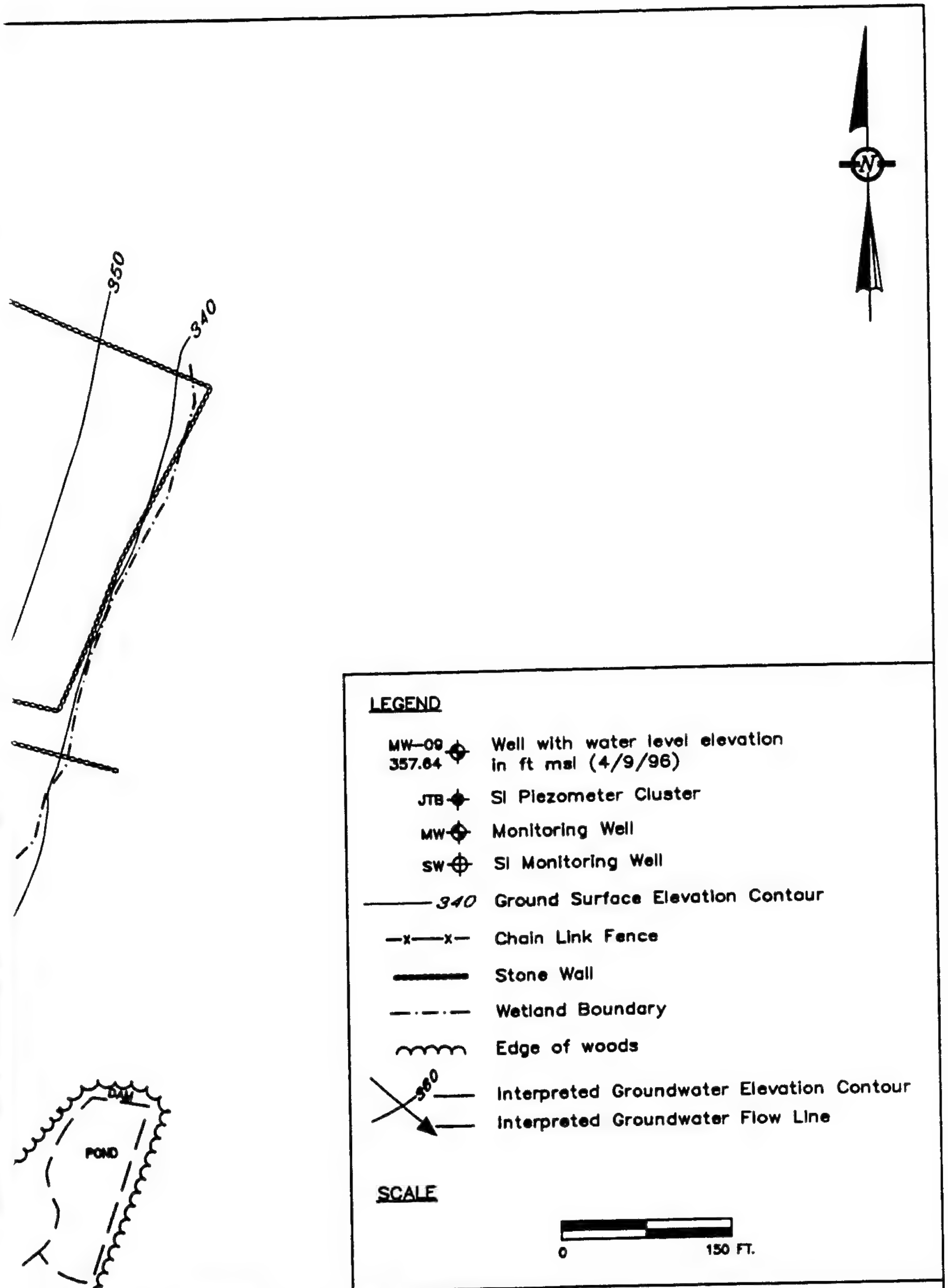

ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 West Central Street, Natick, MA 01760		TITLE FIGURE 5-10 BEDROCK GROUNDWATER CONTOUR MAP 4/9/96 STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK	
APPROVALS	DATE	PREPARED FOR NATIONAL GUARD BUREAU	SCALE 1 IN. = 150 FT.
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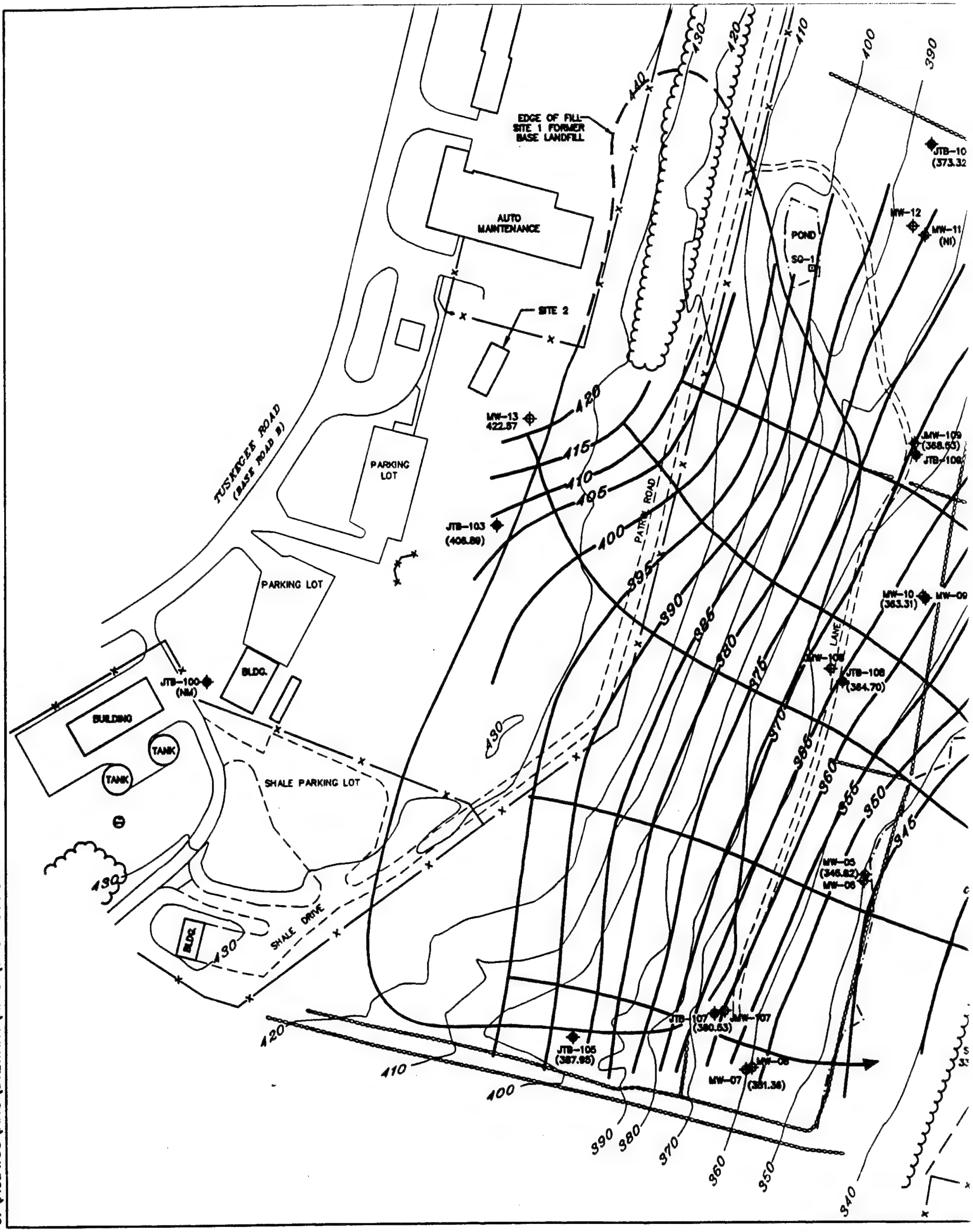

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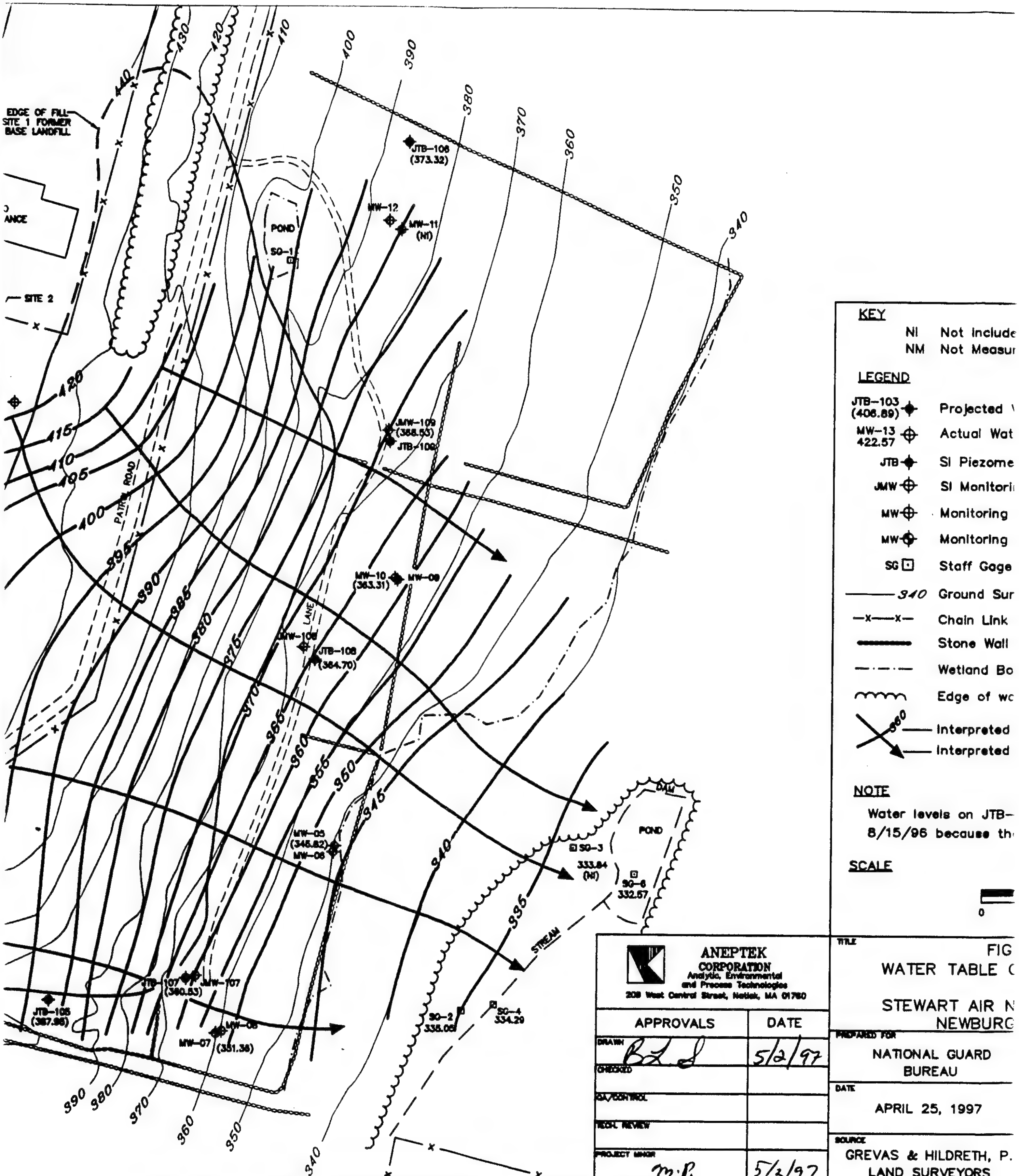
EDGE OF FILL SITE 1 FORMER BASE LANDFILL
SITE 2
POND
SG-1
MW-12
MW-11 (NI)
JTB-106 (373.32)
JMW-109 (368.53)
JTB-109
MW-10 (363.31)
MW-09
JMW-108
JTB-108 (364.70)
MW-05 (345.82)
MW-06
JTB-107 (360.53)
JMW-107
MW-07
MW-08 (351.38)
JTB-105 (387.86)
SG-2 335.06
SG-4 334.29
SG-3 333.84 (NI)
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JTB-103 (406.89) Projected
MW-13 422.57 Actual Wat
JTB SI Piezome
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MW Monitoring
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SG Staff Gage
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NOTE
Water levels on JTB-
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ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
APPROVALS
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TECH. REVIEW
PROJECT MNGR
m.P.
5/2/97
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APRIL 25, 1997
SOURCE
GREVAS & HILDRETH, P.
LAND SURVEYORS

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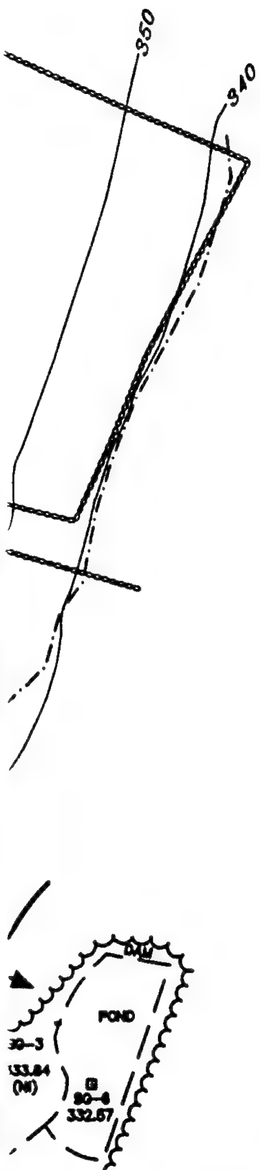

KEY

NI Not Included
NM Not Measured

LEGEND

JTB-103 (406.89) Projected Water Table Elevation
MW-13 422.57 Actual Water Table Elevation
JTB SI Piezometer Cluster
JMW SI Monitoring Well
MW Monitoring Well (screened in overburden)
MW Monitoring Well (screened in bedrock)
SG Staff Gage
340 Ground Surface Elevation Contour
—x—x— Chain Link Fence
Stone Wall
Wetland Boundary
Edge of woods
360 Interpreted Groundwater Elevation Contour
Interpreted Groundwater Flow Line

NOTE

Water levels on JTB-100 were not measured during 8/15/96 because the well could not be accessed.

SCALE

0 150 FT.

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Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760

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TECH. REVIEW	
PROJECT MNGR m.P.	5/2/97

TITLE
FIGURE 5-11
WATER TABLE CONTOUR MAP 8/15/96

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 25, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

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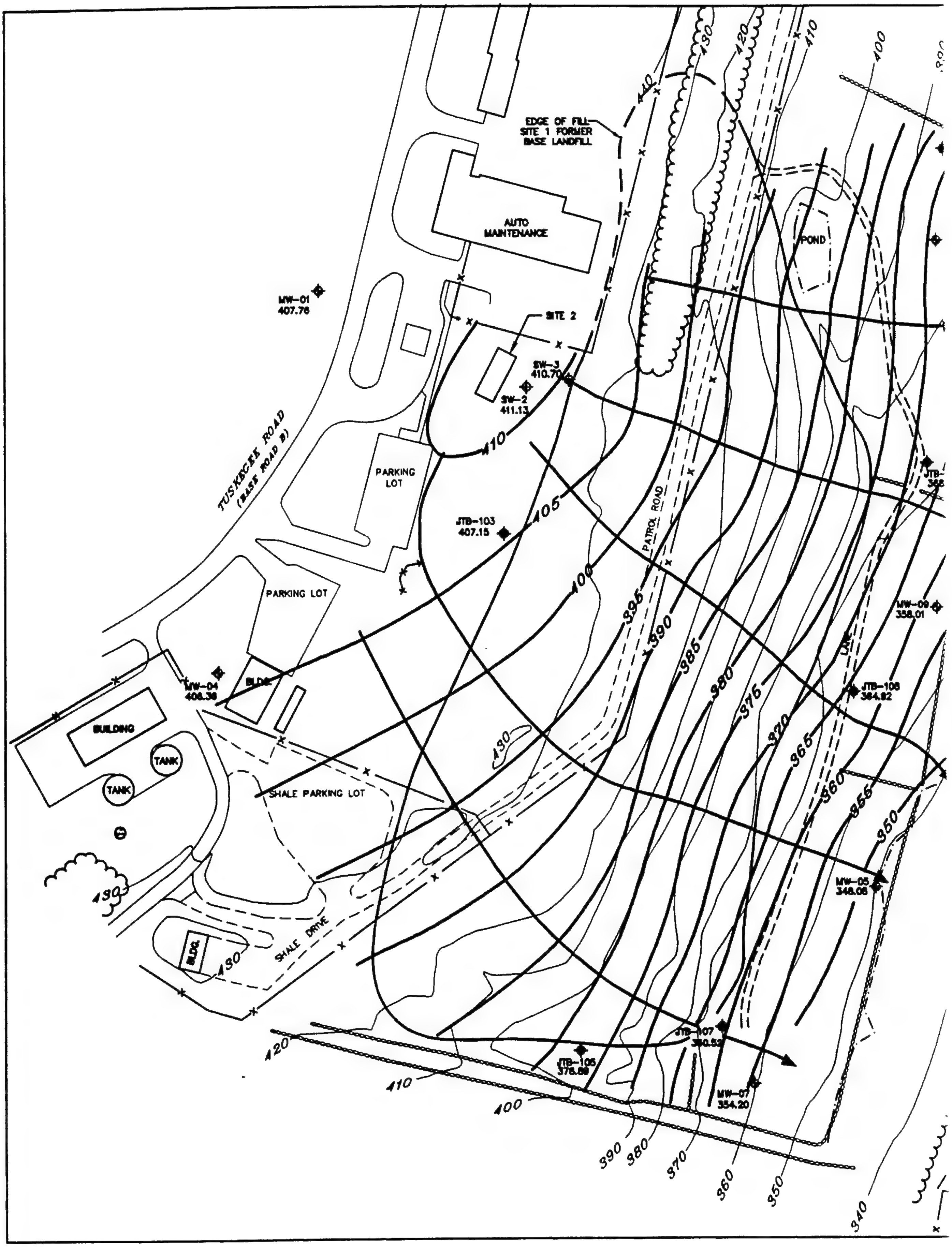

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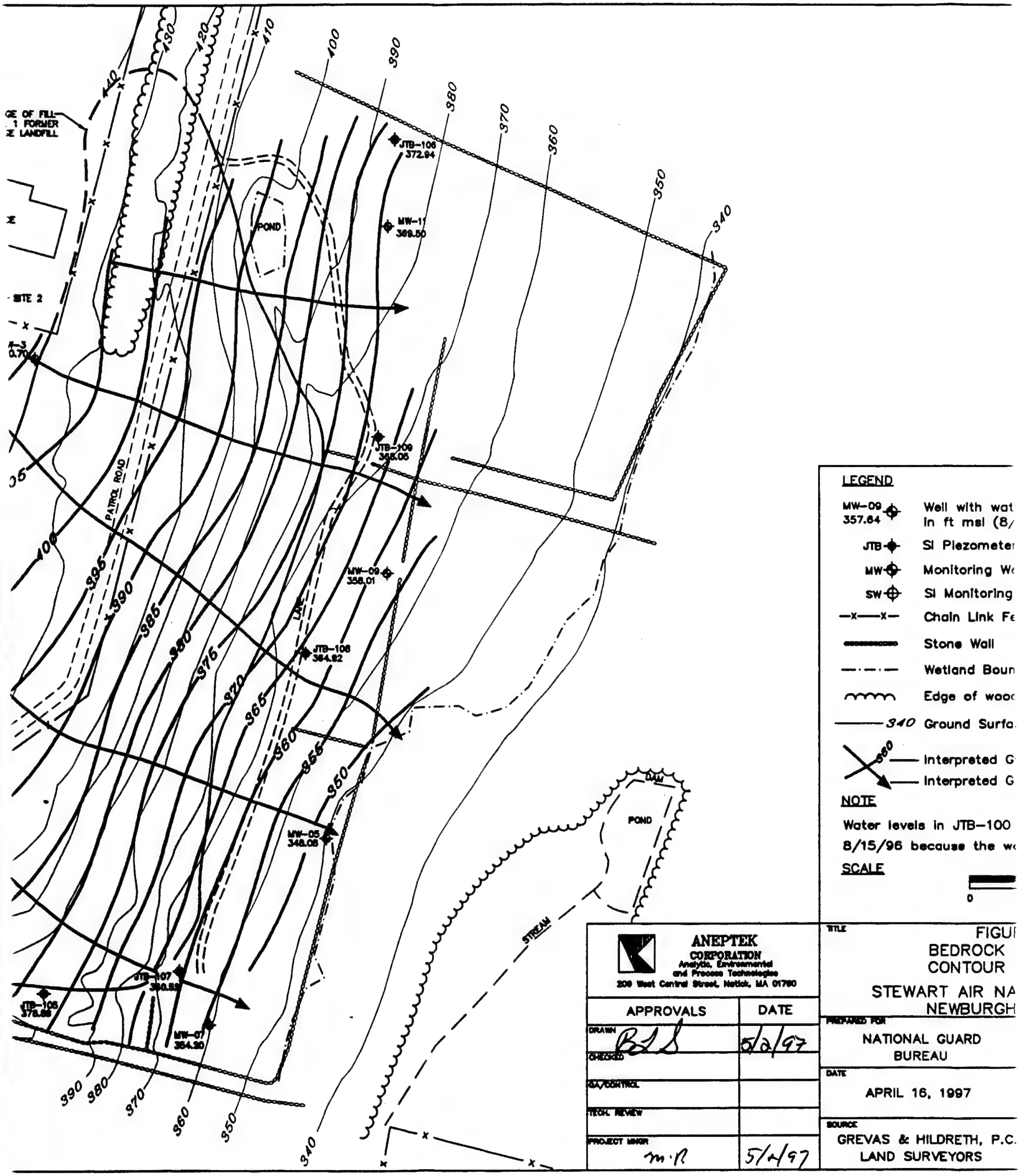

GE OF FILL— .1 FORMER E LANDFILL
SITE 2
PATROL ROAD
POND
JTB-106 372.94
MW-11 369.50
JTB-109 365.06
MW-09 358.01
JTB-108 364.92
MW-05 348.08
JTB-107 360.63
JTB-105 378.68
MW-07 354.20
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LEGEND
MW-09 357.64 Well with wat in ft msl (8/
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NOTE
Water levels in JTB-100 8/15/96 because the w
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BEDROCK
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STEWART AIR NA
NEWBURGH
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NATIONAL GUARD BUREAU
DATE
APRIL 16, 1997
SOURCE
GREVAS & HILDRETH, P.C. LAND SURVEYORS

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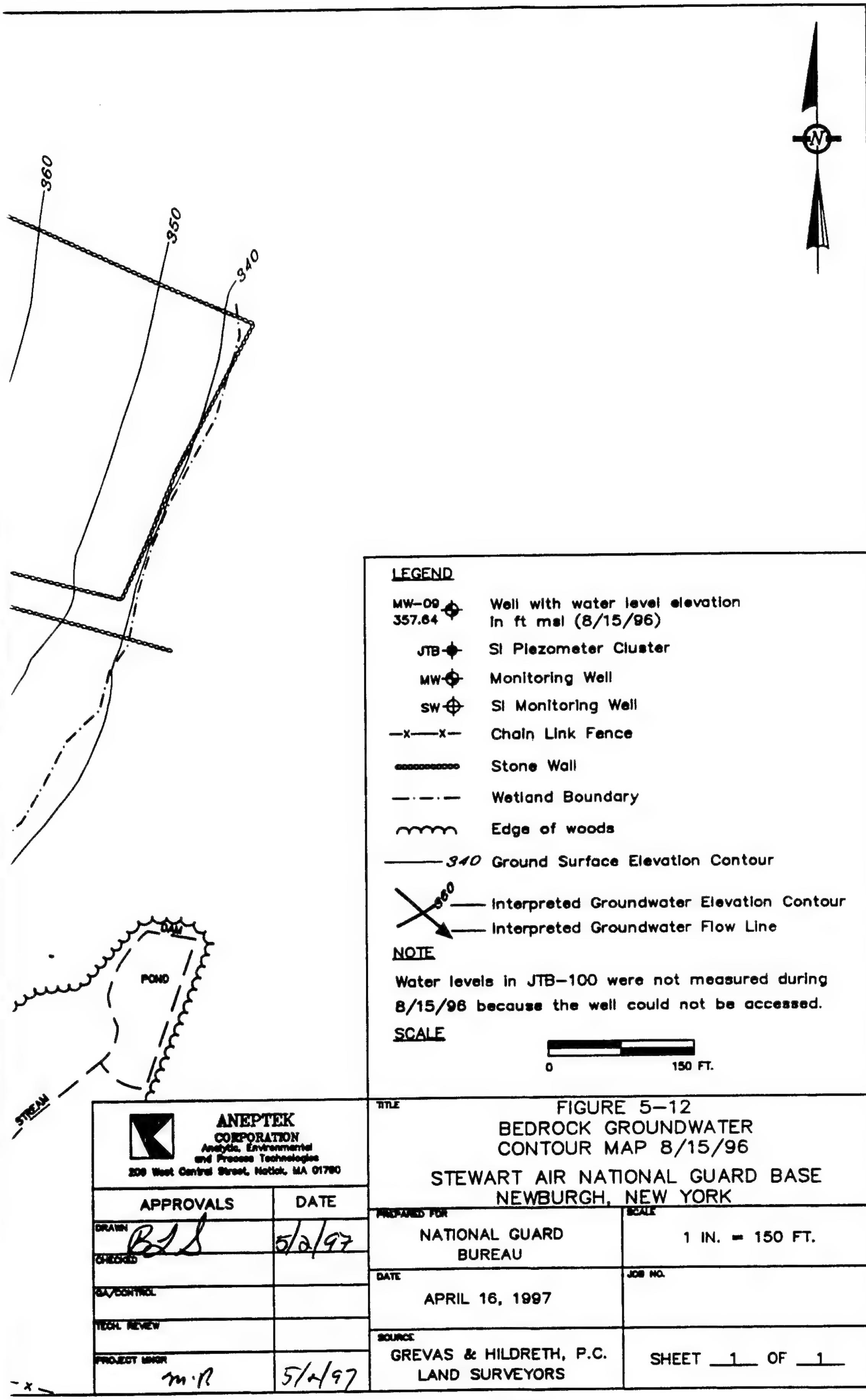

LEGEND

MW-09 357.64 — Well with water level elevation in ft msl (8/15/96)

JTB — SI Piezometer Cluster

MW — Monitoring Well

SW — SI Monitoring Well

—x——x— Chain Link Fence

Stone Wall

Wetland Boundary

Edge of woods

340 Ground Surface Elevation Contour

Interpreted Groundwater Elevation Contour

Interpreted Groundwater Flow Line

NOTE

Water levels in JTB–100 were not measured during 8/15/96 because the well could not be accessed.

SCALE

0 150 FT.

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760

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QA/CONTROL	
TECH. REVIEW	
PROJECT MNGR m.R	5/2/97

TITLE
FIGURE 5–12
BEDROCK GROUNDWATER
CONTOUR MAP 8/15/96
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 16, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

3

soils, leading to a "mounding" condition. It is probable that this observed groundwater high is not a regional condition, given the steady increase in surface elevation to the west and northwest of the study area, and the fact that the site is located on the far east side of a pre-existing drumlin. The third interpretation is that the landfill at Site 1 does not seem to be saturated, based on estimates of the water table elevation and projections of the thickness of fill. Although the exact thickness of fill beneath the central portion of Site 1 is unknown, an estimate of fill thickness was made on the hydrogeologic cross sections (Figures 5-4 and 5-5) and flow net sections (Figures 5-13 and 5-14) using the known edge of fill from test pit data and projecting a smooth curve from areas of original topography. The disposal history of the landfill suggests that refuse was simply dumped on existing slopes and not placed in excavations. In addition, no evidence of groundwater or leachate seeps from the landfill or slopes downgradient of the landfill have been observed at any time during this investigation. These data support the interpretation that the fill is unsaturated.

In both the overburden and bedrock, the interpreted horizontal gradient is approximately 0.11 in the area of the steep slopes beneath Site 1. Further east in the overburden (beneath the wetlands), the horizontal gradient is interpreted to be approximately 0.06, or approximately half the gradient interpreted beneath the landfill.

5.1.2.2 Vertical Gradients

Table 5-4 summarizes the vertical gradient calculations for each round of water level measurements. Vertical gradient calculations are presented in Appendix F.

Figures 5-13 and 5-14 are vertical flow net cross sections constructed along two cross sections through the central and southern portions of the study area to evaluate: (1) how groundwater flows, and (2) how vertical gradients vary. The flow nets were constructed by posting total head elevation at the elevation head elevation at each well screen. Where applicable, projected water table elevations were also posted on the sections. Piezometric contours were constructed by linear interpolation. Flow lines were added to the nets, taking into account the 6:1 vertical to horizontal exaggeration of the cross section using methodology developed by van Everdingen (1963).

In most cases, vertical gradients in well pairs were consistent in both direction and magnitude during the four measurement rounds. Table 5-4 shows strongly downward gradients (in the 0.1 to 0.01 magnitude) west of Site 1 and at topographically higher elevations elsewhere in the study area (in the vicinity of Site 2). Vertical gradients remain downwards in well clusters at lower elevations of the study area that are located more than 140 feet from the wetlands boundary. Upward gradients were observed at JTB-108, MW-05/06 and MW-07/08, all of which are located in the vicinity of the wetlands west of Murphy's Gulch in the southern portion of the study area.

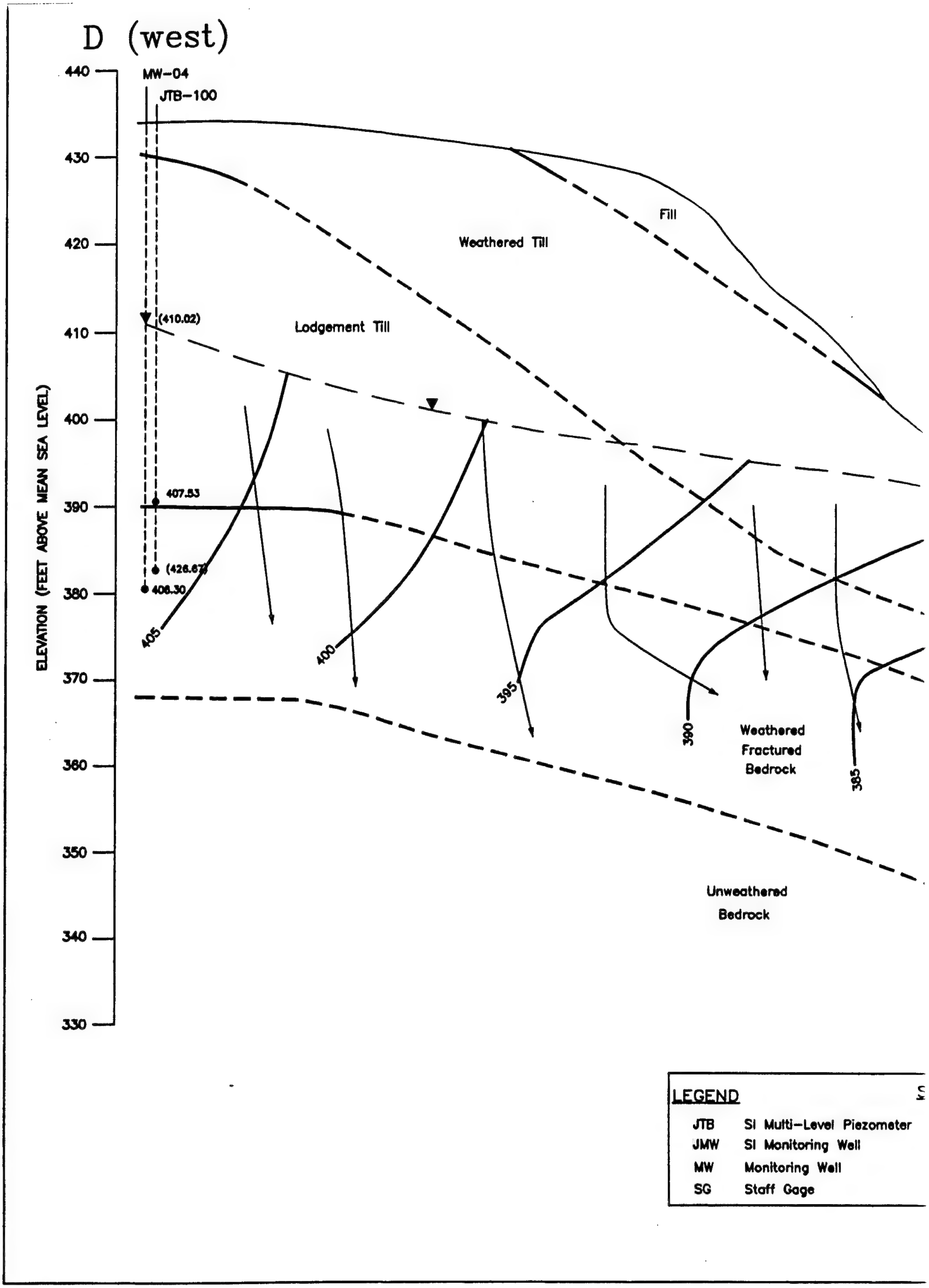
The flow net cross sections in Figures 5-13 and 5-14 illustrate the vertical flow pattern in this study area. Downward gradients persist until the approximate toe of the landfill, where flow

TABLE 5-4
VERTICAL GRADIENT COMPARISON
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

WELL PAIR	Dec-95 VERTICAL GRADIENT (ft/ft)	Mar-96 VERTICAL GRADIENT (ft/ft)	Apr-96 VERTICAL GRADIENT (ft/ft)	Aug-96 VERTICAL GRADIENT (ft/ft)
MW-05 MW-06	0.0357	0.0535	0.0630	0.0796
MW-07 MW-08	0.1145	0.0996	0.1114	0.0154
MW-09 MW-10	-0.4296	-0.3237	-0.3015	-0.3096
MW-11 MW-12	-0.6079	-0.6184	-0.6600	-0.6589
SW-2 MW-13	-0.3552	-0.3401	-0.3513	-0.3388
MW-14 MW-15	NM	NM	NM	-0.3673
MW-04 JTB-100 (b)	-0.1897	NM	-0.1268	NM
JTB-103(a) JTB-103 (b)	0.3574	-0.0074	-0.0372	0.0106
JTB-105 (a) JTB-105 (b) JTB-105 (c)	NM NM	NM NM	-0.0191 -0.4211	-0.0191 -0.4367
JTB-106 (a) JTB-106 (b)	-0.0478	-0.0167	-0.0389	-0.0289
JTB-107 (a) JTB-107 (b)	-0.0029	-0.0529	-0.0019	-0.0010
JTB-108 (a) JTB-108 (b)	NM	NM	0.0200	0.0122
JTB-109 (a) JTB-109 (b)	-0.0531	-0.0146	-0.0292	-0.0313

ABBREVIATIONS
ft - feet
NM - Water levels not measured.

NOTES
1. See Appendix F, Tables F-6, F-7, F-8 for calculations
2. By convention a positive gradient indicates an upward gradient, and a negative gradient indicates a downward gradient.



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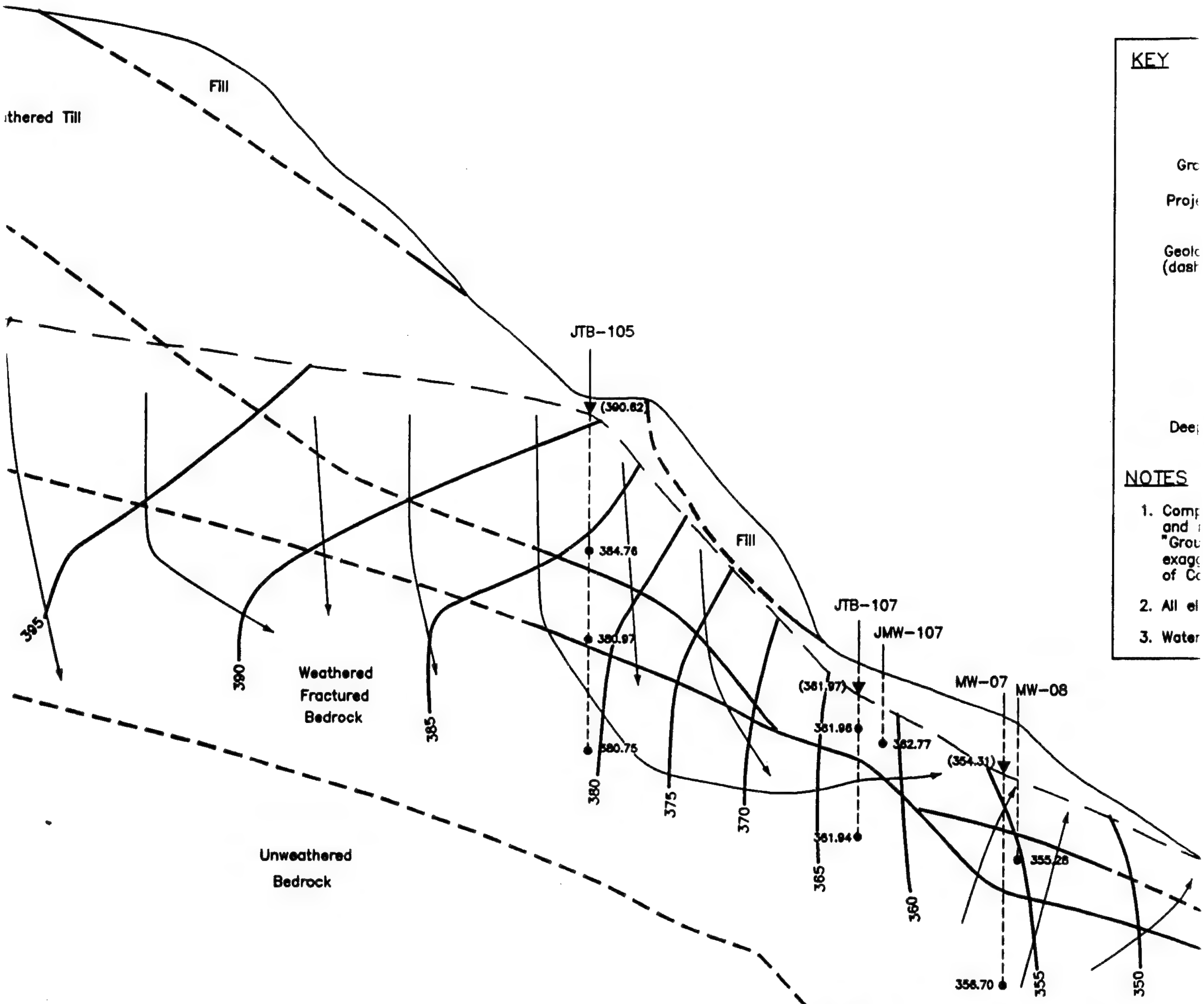

KEY

Grc

Proj

Geolc
(dash

Dee

NOTES

1. Comp
and
"Grou
exag
of Co

2. All el

3. Water

LEGEND

JTB	SI Multi−Level Piezometer
JMW	SI Monitoring Well
MW	Monitoring Well
SG	Staff Gage

SCALE

Horizontal
0 90 FT.
0 15 FT.
Vertical

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APPROVALS	DATE
DRAWN BZS	5/2/97
CHECKED	
QA/CONTROL	
TECH. REVIEW	
PROJECT MNGR m.n.	5/2/97

TITLE
FLOW
STEWAR
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PREPARED FOR
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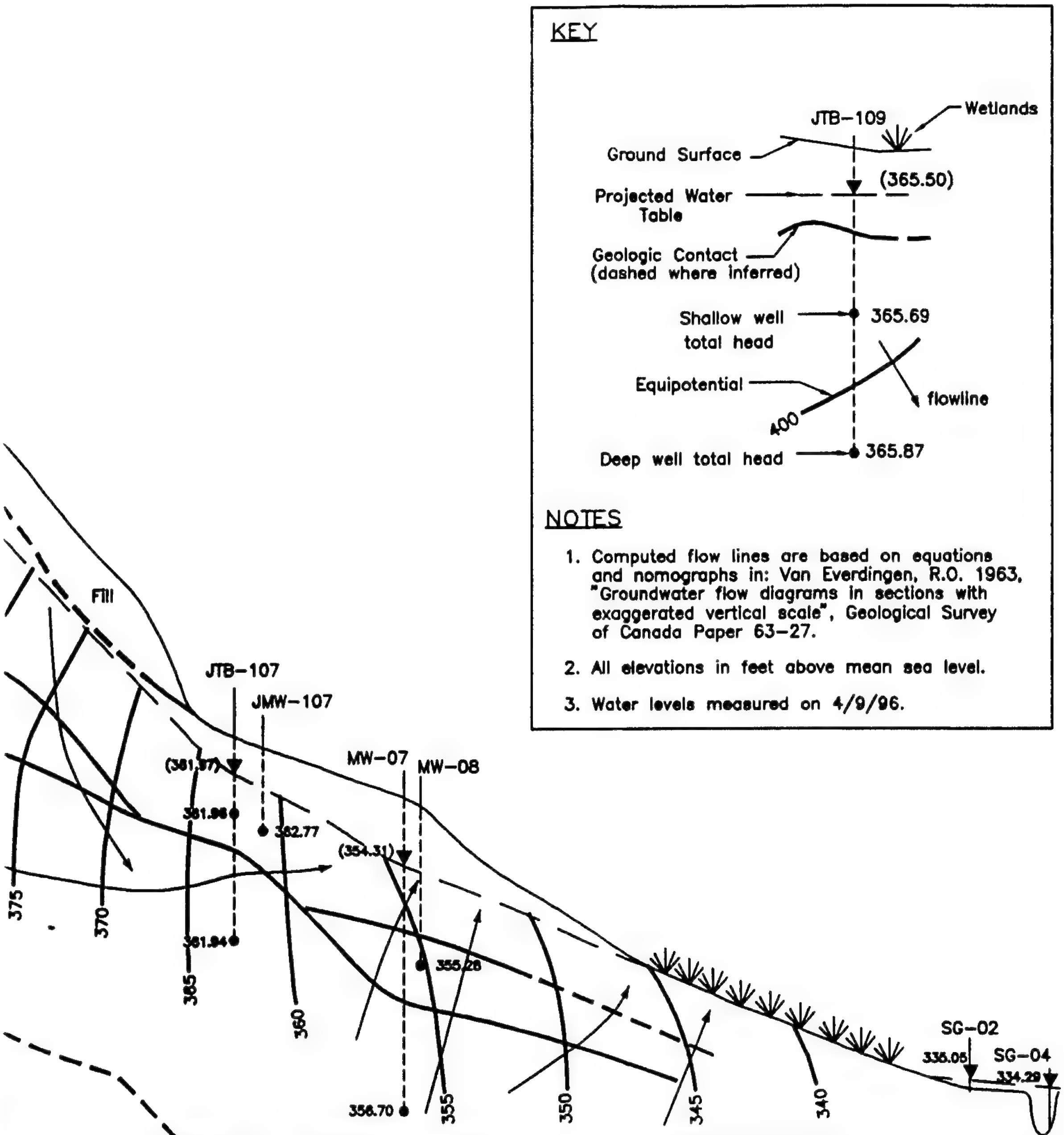
DATE
APRIL 16,

SOURCE

2

D' (east)



NOTES

1. Computed flow lines are based on equations and nomographs in: Van Everdingen, R.O. 1963, "Groundwater flow diagrams in sections with exaggerated vertical scale", Geological Survey of Canada Paper 63-27.
2. All elevations in feet above mean sea level.
3. Water levels measured on 4/9/96.

FT.
FT.

ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 West Central Street, Natick, MA 01760		TITLE FIGURE 5-13 FLOW NET CROSS SECTION D – D' STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK	
APPROVALS	DATE	PREPARED FOR NATIONAL GUARD BUREAU	SCALE HORIZONTAL: 1 IN. = 50 FT. VERTICAL: 1 IN. = 10 FT.
DRAWN BZS	5/2/97		
CHECKED		DATE APRIL 16, 1997	JOB NO.
QA/CONTROL			
TECH. REVIEW		SOURCE	
PROJECT MNGR m. n.	5/2/97		SHEET 1 OF 1

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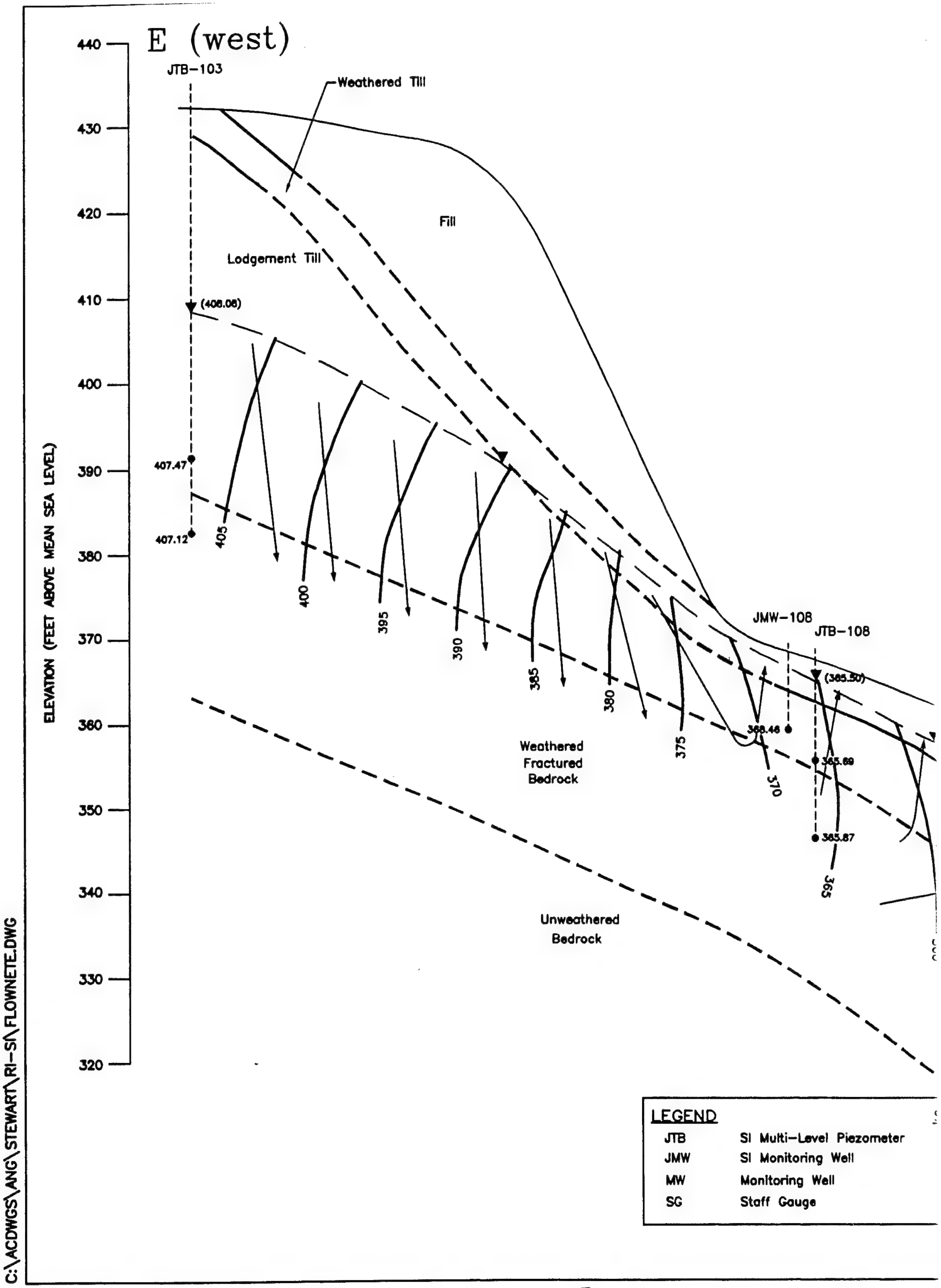
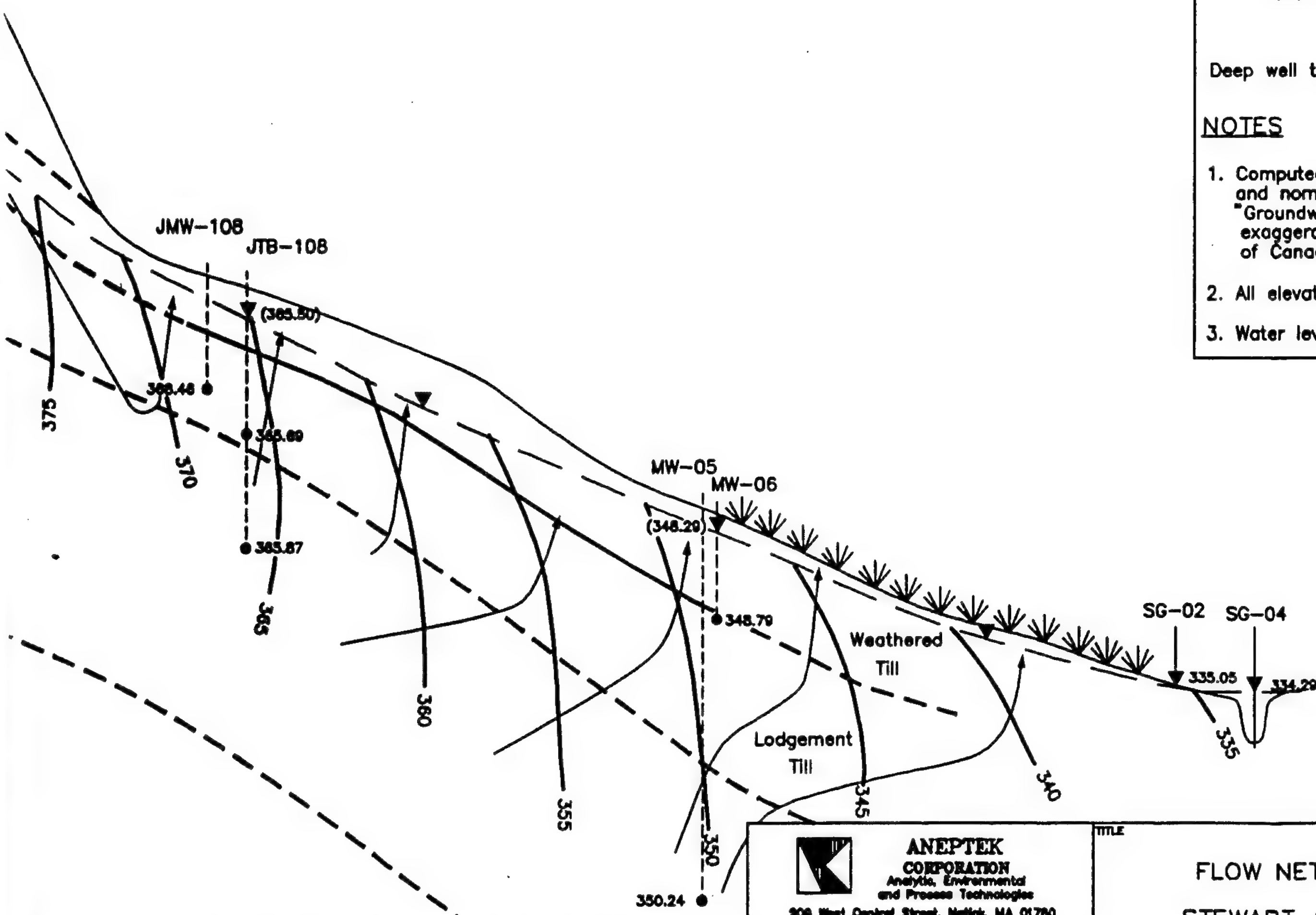


E (west)
JTB-103
Weathered Till
Fill
Lodgement Till
(408.08)
407.47
407.12
405
400
395
390
385
380
375
370
365
JMW-108
JTB-108
(365.50)
368.46
365.69
365.87
Weathered Fractured Bedrock
Unweathered Bedrock
ELEVATION (FEET ABOVE MEAN SEA LEVEL)
440
430
420
410
400
390
380
370
360
350
340
330
320
LEGEND
JTB SI Multi-Level Piezometer
JMW SI Monitoring Well
MW Monitoring Well
SG Staff Gauge
C:\ACDWGS\ANG\STEWART\RI-SI\FLOWNETE.DWG

1



KEY

JTB-

Ground Surface

Projected Water Table

Geologic Contact (dashed where inferred)

Shallow well total head

Equipotential

400

Deep well total head

NOTES

1. Computed flow lines are ba and nomographs in: Van Ev "Groundwater flow diagrams exaggerated vertical scale", of Canada Paper 63-27.
2. All elevations in feet above
3. Water levels measured on 4

LEGEND

JTB	SI Multi-Level Piezometer
JMW	SI Monitoring Well
MW	Monitoring Well
SG	Staff Gauge

SCALE

Horizontal

0 90 FT.

0 15 FT.

Vertical

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TECH. REVIEW	
PROJECT MNGR m.p.	5/2/97

TITLE

FIGURE 5-14
FLOW NET CROSS SECTI

STEWART AIR NATIONAL
NEWBURGH, NEW Y

PREPARED FOR
NATIONAL GUARD BUREAU

SCALE
HORIZO
VERTIC

DATE
APRIL 16, 1997

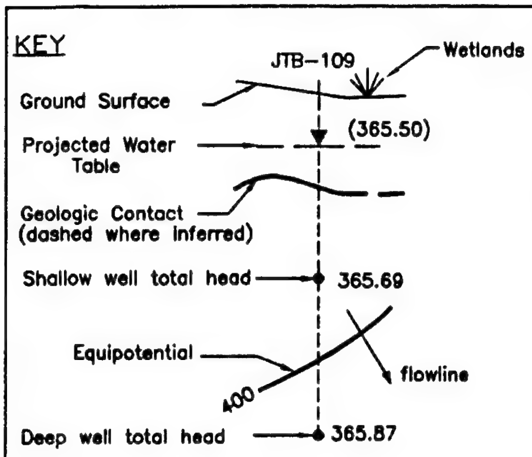
JOB NO.

SOURCE

SHEET

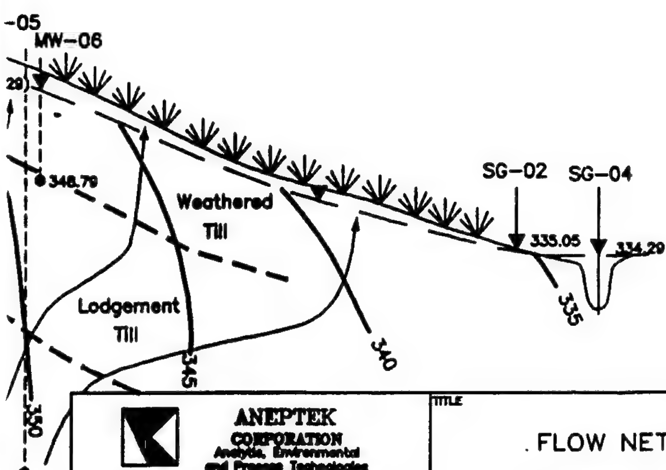
2

E' (east)



NOTES

1. Computed flow lines are based on equations and nomographs in: Van Everdingen, R.O. 1963, "Groundwater flow diagrams in section with exaggerated vertical scale", Geological Survey of Canada Paper 63-27.
2. All elevations in feet above mean sea level.
3. Water levels measured on 4/9/96.



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APPROVALS	DATE
DRAWN [signature]	5/2/97
CHECKED	
QA/CONTROL	
TECH. REVIEW	
PROJECT MNGR m.p.	5/2/97

TITLE
FIGURE 5-14
FLOW NET CROSS SECTION E - E'
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR	SCALE
NATIONAL GUARD BUREAU	HORIZONTAL: 1 IN. = 50 FT. VERTICAL: 1 IN. = 10 FT.
DATE APRIL 16, 1997	JOB NO.
SOURCE	SHEET 1 OF 1

3

is almost horizontal (such as at JTB-107 or JTB-108), then are strongly upwards towards the wetlands and Murphy's Gulch. The flow nets support the interpretation that the wetlands and Murphy's Gulch receive recharge from both the overburden and bedrock flow systems. In addition, Figure 5-13 shows very steep vertical gradients in the vicinity of JTB-105, based on the 4-foot head difference observed in JTB-105(c) versus (a) or (b). Similar head differentials were also observed during the SI (Appendix A, Table 7-3). The data in this area suggest local resistance to vertical flow through the till as groundwater discharges from the relatively permeable fill.

The data suggest that groundwater entering the overburden upgradient of Site 1 would migrate vertically to the fractured bedrock flow system and flow through bedrock to the point where gradients reverse and then flow upwards, discharging to the overburden and eventually to surface water.

Substantial variations from the flow pattern described above were observed at three locations:

- At JTB-103, vertical gradients varied in both direction and magnitude during each measurement round. The same pattern was observed over successive measurements obtained during the SI (see Table 7-3 in Appendix A). The greatest head differential observed during the current investigation was December 1995 (3.36 feet). During the SI, a differential of 5.50 feet was observed in January 1989. The reason for this variation is not clear, but it may be related seasonal variations and to the location of the piezometer cluster near the westernmost limit of the local overburden aquifer. At the outset of this investigation during the fall of 1995, most of the overburden west of Site 1 was unsaturated.

- At the MW-11/12 cluster, consistent strong downward vertical gradients were observed (Table 5-4). The large head differential in this cluster (over 11 ft) may be due to the completion of MW-12 (the overburden well), in a very shallow interval of the overburden, compared to other piezometer or well clusters. The difference in completion intervals is illustrated in Figure 5-4, cross section B-B' across the base of the landfill toe. MW-12 was completed in this interval because groundwater was encountered at a comparatively shallow depth. When the companion MW-11 boring was being advanced, split spoons samples were saturated at 8 to 16 feet bgs, then were logged as slightly moist in deeper intervals. In addition, hydraulic conductivity measured at this cluster was the lowest observed in the study area 0.06 feet per day [ft/d]. A plausible explanation for this observation is that overburden groundwater at this location may be locally mounded due to downward seepage from the small retention pond located directly upgradient of the well cluster. Additionally, local till fractures may influence flow in this area. Note also that nearby JTB-106 (see Figure 5-3) does not exhibit this behavior.

  Projecting the water table elevation at this cluster using the April, 1996 data would lead to a water table at 400 feet msl (see Appendix F, Table F-5), which would be well above ground surface (387 feet msl). Although the water level in MW-12 was within the well

screen interval during the August 1996 measurement round, the water level elevation was still substantially higher than other well clusters in the vicinity. Overall, the data suggest that groundwater flow in the shallow overburden at the MW-11/12 cluster may influenced by several factors and that the connection between MW-12 and the deeper overburden and bedrock flow systems is poor, especially when compared with nearby JTB-106. For this reason, overburden water level data from MW-12 were not used in the water table contour maps presented in Figures 5-9 and 5-11.

- A large head differential was observed in the JTB-100 cluster during the first three measurement rounds (it was not measured during the last round in August, 1996). The water level in bedrock piezometer JTB-100(a) was 20 feet higher than the overburden piezometer as well as the water level in nearby MW-04. This differential is illustrated in Figure 5-5. Because this large difference in head was not observed in measurements obtained during the SI (Appendix A, Table 7-3), it is assumed that the head in JTB-100(a) does not currently reflect aquifer conditions. Instead, to evaluate vertical gradients, comparisons were made between MW-04 and JTB-100(b). Vertical gradients in this area are consistently downward in the 0.1 ft/ft range, based on this comparison.

5.1.2.3 Effective Porosity

Effective porosity is defined as the volume of interconnected void spaces contributing to fluid flow in a porous medium, divided by the total volume of the medium (Fetter, 1988). No direct measurements of effective porosity were obtained for either the overburden or the bedrock in this study. However, available data can be used to derive an estimate of this property from literature values or formulas.

In the overburden, effective porosity can be estimated from grain size data. Johnson (1967) provides several methods for using grain size data to estimate formation specific yield, which is defined similarly to effective porosity in this publication. Several grain size analyses were performed during the SI, the results of which are summarized in Table 5-5. This table shows that on average, the silt and clay fraction of the till comprises 44 percent of samples by weight. Although no hydrometer analyses were performed, it is reasonable to assume that approximately half the silt and clay percentage consists of clay-sized material, because the parent rock is predominantly shale, which is composed mostly of clay. Review of similarly sorted materials illustrated in Johnson (1967) suggest that the effective porosity of the till is probably in the range of 1 to no more than 10 percent.

Effective porosity in the fractured bedrock (n_e) was assessed by estimating the average number of fractures per unit foot of core (N), assuming an effective fracture aperture width (b) and applying these values to the following formula (Freeze and Cherry, 1979):

$$n_e = Nb$$

Based on a detailed inspection of the cores, the average number of fractures per foot is

TABLE 5-5
SITE INSPECTION GRAIN SIZE ANALYSIS DISTRIBUTION SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE	PERCENT PASSING 3-INCH SIEVE	PERCENT PASSING NO. 4 SIEVE	PERCENT PASSING NO. 10 SIEVE	PERCENT PASSING NO. 200 SIEVE	COARSE-FINE GRAVEL (75-4.7 mm)	COARSE SAND (4.7-2 mm)	MEDIUM-FINE SAND (2-0.074 mm)	SILT & CLAY (< 0.074 mm
MW101 S1	100	73	66	40	27	7	26	40
MW109 S1	100	71	61	29	29	10	32	29
MW100 S3	100	80	64	27	20	16	37	27
B100 S3	100	74	68	43	26	6	25	43
B101 S4	100	91	83	55	9	8	28	55
B102 S6	100	85	77	52	15	8	25	52
B103 S2	100	92	82	46	8	10	36	46
B103 S7	100	82	74	46	18	8	28	46
B104 S4	100	81	74	44	19	7	30	44
B105 S5	100	98	92	69	2	6	23	69
B106 S3	100	86	77	34	14	9	43	34
B106 S5	100	87	78	40	13	9	38	40
B107 S2	100	92	90	62	8	2	28	62
B108 S3	100	78	71	35	22	7	36	35
B110 S4	100	90	82	40	10	8	42	40
Arithmetic Mean					16	8	32	44

ABBREVIATIONS
mm - millimeters

REFERENCE
E. C. Jordan, 1989

approximately 4. Assuming an in-situ aperture width of 1 millimeter (mm) to 5 mm (3.28×10^{-3} to 2×10^{-2} feet), based on the tightness of fit of reassembled core fragments, effective fracture porosity is estimated at 1 to 8 percent. Effective porosity is likely higher in the southern portion of the study area (in the vicinity of MW-07) where the core was so fractured the structure of the rock could not be evaluated.

5.1.2.4 Hydraulic Conductivity

Hydraulic conductivity (K) was estimated from slug tests performed in wells MW-04 through MW-13 installed during the RI and CI. Additionally, all previous slug test data collected by other contractors were also reviewed. The original SI analyses used the wrong saturated well screen lengths, resulting in incorrect calculated hydraulic conductivity values. As a result, SI slug test data were re-analyzed. All data were analyzed by the Bouwer and Rice method (Bouwer, 1989) using the slug-test analysis computer program, BRISTA (Smith, 1995). This program is an interactive program that allows the user to visually curve-fit plotted slug test data and calculate hydraulic conductivity. All input data and program output are provided in Appendix G. Results are summarized on Table 5-6.

In the overburden, hydraulic conductivity values range from 0.06 to 1.88 feet/day (ft/d) (2.27×10^{-5} to 6.64×10^{-4} cm/sec) with a geometric mean value of 0.35 ft/d (1.23×10^{-4} cm/sec). Hydraulic conductivity in wells completed in the weathered till (MW-06, MW-12 and JMW-107) ranged from 0.06 to 0.45 ft/d (2.27×10^{-5} to 1.58×10^{-4} cm/sec). All remaining overburden wells were completed in the unweathered till. The range in calculated hydraulic conductivity in these wells was 0.12 to 1.88 ft/d (4.09×10^{-5} to 6.64×10^{-4} cm/sec). In the weathered fractured shale bedrock interval, hydraulic conductivity values range from 0.06 to 1.78 ft/d (2.27×10^{-5} cm/sec to 6.29×10^{-4} cm/sec) with a geometric mean value of 0.22 ft/d (7.84×10^{-5} cm/sec).

Although hydraulic conductivity values vary throughout the study area, a comparison of geometric mean hydraulic conductivity values shows hydraulic conductivity to be only slightly higher in the overburden than bedrock. This difference is not considered significant. Vertical hydraulic conductivity values were not evaluated during this investigation, either by laboratory or field methods. However, given the nature of sediment deposition in this area, vertical hydraulic conductivity values an order of magnitude or more lower than horizontal hydraulic conductivity could be expected.

5.1.2.5 Average Linear Velocity

The actual rate of groundwater movement through the subsurface is referred to as seepage velocity or average linear velocity (V). Table 5-7 summarizes the estimates of horizontal average linear velocity in both the overburden and bedrock based on an equation in Appendix F. More than one estimate is provided due to the range of estimates of effective porosity and hydraulic gradient (in the overburden).

TABLE 5-6
SUMMARY OF SLUG TEST
HYDRAULIC CONDUCTIVITY DATA
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

OVERBURDEN			BEDROCK		
	HYDRAULIC CONDUCTIVITY			HYDRAULIC CONDUCTIVITY	
WELL	(cm/sec)	(ft/d)	WELL	(cm/sec)	(ft/d)
MW-06	1.58E-04	0.45	MW-04	2.29E-04	0.65
MW-08	4.58E-04	1.30	MW-04[1]	2.35E-04	0.67
MW-08[1]	6.64E-04	1.88	MW-05	3.60E-05	0.10
MW-10	2.53E-04	0.72	MW-07	1.88E-04	0.53
MW-10[1]	7.88E-05	0.22	MW-07[1]	1.57E-04	0.45
MW-12	2.27E-05	0.06	MW-09	5.79E-04	1.64
MW-13	1.37E-04	0.39	MW-09[1]	6.29E-04	1.78
JMW-107[2]	1.64E-04	0.47	MW-11	2.20E-05	0.06
JMW-108[2]	4.09E-05	0.12	SW-2[3]	3.70E-05	0.10
JMW-109[2]	1.88E-04	0.53	SW-3[3]	2.57E-05	0.07
Geometric Mean K:	1.24E-04	0.35	Geometric Mean K:	7.84E-05	0.22

ABBREVIATIONS
K - Hydraulic Conductivity
cm/sec - centimeters per second
ft/d - feet per day

NOTES
1 Duplicate analysis performed for quality assurance purposes. Results arithmetically averaged prior to calculation of formation geometric mean.
2 Re-evaluation of E.C. Jordan SI data.
3 Results from Dames & Moore (1986).

TABLE 5-7
AVERAGE LINEAR VELOCITY ESTIMATES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETER VARIED	OVERBURDEN				BEDROCK			
	K (ft/d)	i	ne	Vx (ft/d)	K (ft/d)	i	ne	Vx (ft/d)
High n_e & High i	0.35	0.11	0.10	0.39	0.22	0.11	0.08	0.30
Low n_e & High i	0.35	0.11	0.06	0.64	0.22	0.11	0.01	2.42
High n_e & Low i	0.35	0.06	0.10	0.21				
High n_e & Low i	0.35	0.06	0.06	0.35				

ABBREVIATIONS

K - Hydraulic Conductivity

ft/d - feet per day

n_e - effective porosity

V_x - Horizontal Average Linear Velocity

i - horizontal gradient

In the overburden, horizontal average linear velocity estimates range from 0.21 to 0.64 ft/d. In the bedrock, estimates range from 0.30 to 2.42 ft/d. The relatively high horizontal average linear velocity estimates are due to both the high horizontal gradient and the relatively low formation effective porosity. If, as is expected, overburden vertical hydraulic conductivity is an order or two lower than horizontal hydraulic conductivity, vertical seepage velocity estimates would be correspondingly lower as well.

5.1.3 Surface Water Hydrology

Section 3.4 provides a general discussion of regional and local surface water hydrology. In order to further quantify local surface water hydrology six staff gages were installed during this investigation, although one was lost prior to the completion of the field survey. The remaining five gages were surveyed to the same datum as the monitoring wells. Staff gage SG-1 was located in the constructed "pond" at the northern end of Site 1. Four additional gages were installed in Murphy's Gulch and the sedimentation pond downgradient of Site 1. Staff gages were measured during the December 1995 and April 1996 measurement rounds. Elevation calculations are summarized in Table 5-3. Data from the April 1996 measurement round are posted on Figure 5-9.

Flow net analysis suggests that groundwater discharges to surface water (Section 5.1.2.2) in the vicinity of the wetlands east of Site 1, which are drained by Murphy's Gulch. The actual volume of flow and discharge point to the surface probably varies seasonally as the wetlands and Murphy's Gulch have been observed to have no standing water during drier periods of the year. Water flowing to Murphy's Gulch then flows northward joining the flow originating from the vicinity of the Town of New Windsor landfill southeast of Site 1.

Table 5-3 shows that water levels at the staff gages were similar between measurement rounds, varying more than 0.6 feet only at SG-1 in the constructed "pond" and the detention pond in Murphy's Gulch (1.3 feet at SG-6). Corresponding groundwater elevation changes in selected nearby wells were also compared. Water levels in wells closest to SG-1 (MW-11 and MW-12) varied by 2.14 and 4.61 feet, respectively. Water levels in MW-05 and MW-06, closest to SG-6, varied by 2.31 and 2.91 feet, respectively. Water levels in the MW-05/06 pair, located closer to Murphy's Gulch and the wetlands, appear to track changes in the staff gages more closely than at SG-1. However, this interpretation is based on only three rounds of surface water level measurements. The limited data suggest fairly uniform flow in and to surface water bodies via groundwater discharge and overland flow. Flow is controlled in surface water bodies by berms at pond outlets.

5.2 Background Sampling Results

As discussed in Section 4.0, background samples were collected for groundwater and surface water. Groundwater samples collected from monitoring wells MW-01 and MW-04 provide background groundwater quality data. Surface water samples SW-02-120195 provides background surface water quality data. Analytical results for the background groundwater and

surface water samples are presented in Tables 5-8 and 5-9, respectively.

5.3 Site Findings

This section presents the results of the field program implemented as part of the Site 1 CI.

5.3.1 Explosive Gas Investigation Results

Three rounds of explosive gas measurements were taken, the first round taken on June 26, 1995, the second round taken on March 15, 1996, and the third round taken on September 25, 1996. The barometric pressure was below 29.92 inches of mercury during all three rounds of explosive gas measurements. All readings encountered above background were recorded in the field logbook. Subsurface soils were heavily saturated during the second round of gas measurements, as several of the observation holes filed with water upon removal of the slam-bar. Areas in which total VOCs were encountered above background are identified in Figure 5-15.

First and Second Rounds of Gas Measurements

No readings above background concentrations on either the FID or the 4-gas meter were encountered during the first round of gas measurements. None of the readings taken during the second round were found to be above background concentrations with the exception of two locations shown in Figure 5-15. Readings taken from the well casing of JMW-108 were found to be in the range of 50 to 100 parts per million (ppm) on the FID. A reading taken from a "slam-bar" hole approximately 5 feet from JMW-108 provided readings between 2 to 7 ppm on the FID. No readings above background were encountered at either location on the 4-gas meter.

The other location at which concentrations above background were encountered was near the top break in slope in the northern portion of the landfill. Readings taken at a "slam-bar" location in this area identified the presence of total VOCs at concentrations between 0.1 to 10 percent. An attempt was made to if the excessive moisture may have resulted in the detection of a false positive, by taking a reading above a standing pool of water. Initially, the FID indicated total VOC concentrations up to 0.1 percent before the excessive moisture present caused the flame in the FID to go out. After allowing the instrument to dry out for approximately an hour and a half, an attempt was made to duplicate the high readings encountered by advancing a slam-bar hole approximately 30 feet from the previous location. No readings above background concentrations were encountered. No readings on the 4-gas meter were encountered above background concentrations in this area.

Third Round of Gas Measurements

During the third round of measurements a Foxboro 128 FID was used to monitor total VOCs. This model is able to detect total VOCs up to a maximum concentration of 1,000 ppm. Total VOC concentrations of 1,000 ppm were noted at a handful of slam-bar holes over the flatter portions of the landfill. These concentrations were noted when the probe of the FID was inserted

TABLE 5 - 8
SITE 1 GROUNDWATER ANALYSIS SUMMARY
BACKGROUND SAMPLES
STEWART AIR NATIONAL GUARD
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS	UNITS	FEDERAL MCL	NEW YORK DWQS[3]	SAMPLE NUMBER MW-01-113095†		MW-04-120195	
FIELD PARAMETERS								
Eh	NA	millivolts	NA	NA	96.1		104.6	
pH	NA	Std. Units	NA	NA	10.7		7.43	
Dissolved Oxygen[1]	NA	mg/L	NA	NA	1.06		0.27	
Field Observations[2]	NA	NA	NA	NA	-		-	
Floaters or Sinkers	NA	NA	NA	NA	-		-	
Specific Conductance	NA	µohms/cm	NA	NA	0.458		0.435	
Temperature	NA	°C	NA	NA	10.6		9.2	
LEACHATE INDICATORS								
BOD	3.0	mg/L	NA	NA	3	U	14.1	
COD	< 2.0	mg/L	NA	NA	12		21.8	
TDS	2.0	mg/L	NA	NA	180		358	
TOC	0.5	mg/L	NA	NA	1.3		7.7	
Alkalinity	2.0	mg/L	NA	NA	131		176	
Ammonia-Nitrogen	0.2	mg/L	NA	2	0.2	U		R
Boron	2.5	µg/L	NA	1000	76.6		59.9	
Chloride	2.0	mg/L	NA	250	2	U	2	U
Color	5.0	Pt-Co	NA	NA	10		10	
Nitrate-Nitrite	0.2	mg/L	NA	10	0.2	U	0.2	U
Sulfate	5.0	mg/L	NA	250	76		112	
Total Hardness as CaCO(3)	2.5	mg/L	NA	NA	103		226	
Total Kjeldahl Nitrogen	0.5	mg/L	NA	NA	0.5	U	0.5	U
Total Phenols	0.01	mg/L	NA	NA	0.01	U	0.01	U
Turbidity	NA	NTUs	NA	NA	240		999	
INORGANIC PARAMETERS								
Aluminum	17.4	µg/L	NA	NA	557		53.1	J
Antimony	21.1	µg/L	6	3	34.1	J	23.4	U
Arsenic	1.1	µg/L	50	25	7.3	J	1.2	U
Barium	0.7	µg/L	2000	1000	14.3	J	12.0	J
Beryllium	1.1	µg/L	4	3	1.2	U	1.2	U
Bromide	1.0	mg/L	10	2000	1	U	1	U
Cadmium	2.4	µg/L	5	10	6.1		2.7	U
Calcium	10.3	µg/L	NA	NA	35600	J	70500	
Chromium	2.0	µg/L	100	50	14.7		10.3	U
Cobalt	6.4	µg/L	NA	NA	7.1	U	7.1	U
Copper	2.4	µg/L	1300	200	9.5	J	3.9	J
Cyanide- Total	10	µg/L	200	100	10	U	10	U
Hexavalent Chromium	0.01	mg/L	NA	50	0.01	U	0.01	U
Iron	5.2	µg/L	NA	300	711		42.6	J
Lead	0.5	µg/L	15	25	2.0	J	1.8	J
Magnesium	14	µg/L	NA	35000	3380	J	12000	
Manganese	0.9	µg/L	NA	300	27.3	J	783	
Mercury	0.2	µg/L	2	2	0.2	U	0.2	U
Nickel	12.7	µg/L	100	NA	14.1	U	17.2	J
Potassium	60.7	µg/L	NA	NA	2020	J	1590	J
Selenium	1.4	µg/L	50	10	1.6	U	1.6	U
Silver	1.9	µg/L	NA	50	4.1	J	2.7	J
Sodium	22.8	µg/L	NA	20000	57900	J	24400	
Thallium	1.1	µg/L	2	4	1.2	J	1.2	U
Vanadium	3.1	µg/L	NA	NA	30.8	J	4.8	J
Zinc	1.3	µg/L	NA	300	265	J	43.1	J
ORGANIC PARAMETERS								
Acetone	10	µg/L	NA	NA	10	U	1	J
Carbon Disulfide	10	µg/L	NA	NA	10	U	10	U
Chloroethane	10	µg/L	NA	NA	10	U	10	U
Chloroform	10	µg/L	100	7	2	J	10	U
Methylene Chloride	10	µg/L	NA	5	10	U	10	U
1,1-Dichloroethane	10	µg/L	NA	5	10	U	10	U
1,1-Dichloroethene	10	µg/L	7	5	10	U	10	U
1,1,1-Trichloroethane	10	µg/L	200	5	10	U	10	U

ABBREVIATIONS
COD- Chemical Oxygen Demand
BOD- Biochemical Oxygen Demand
MCL - Maximum Contaminant Level
NA - Not applicable
NTUs - Nephelometric Turbidity Units
NYSDEC - New York State Department of Environmental Conservation
PT-CO - Platinum Cobalt Standard
TOC- Total Organic Carbon
TDS- Total Dissolved Solids
mg/L= milligrams per liter
µg/L= micrograms per liter

DATA QUALIFERS
J - Estimated value
R - Rejected value
U - Undetected

NOTES
1) In situ dissolved oxygen readings taken 8/14/96.
2) Unless noted on table there were no unusual field observations or floaters or sinkers associated with that sample.
3) NYSDEC Water Quality Standards and Guidance Values, November, 1991.
5.2 -Exceeds water quality guideline
†) Sample collected over a two day period due well going dry.

TABLE 5 - 9
SITE 1 SURFACE WATER ANALYSIS SUMMARY
BACKGROUND SAMPLE
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS	UNITS	FEDERAL AWQC[1]	NEW YORK AWQS[1]	SAMPLE NUMBER SW-02	
FIELD PARAMETERS						
Dissolved Oxygen	NA	mg/L	NA	> 4.0	13.76	
Eh	NA	millivolts	NA	NA	193.1	
Field Observations[2]	NA	NA	NA	NA	-	
Floaters or Sinkers	NA	NA	NA	NA	-	
pH	NA	Std. Units	6.5-9.0	6.5-8.5	6.41	
Specific Conductance	NA	µohms/cm	NA	NA	0.455	
Temperature	NA	°C	NA	NA	1.5	
LEACHATE INDICATORS						
BOD	3.0		NA	NA	3	U
COD	< 2.0	mg/L	NA	NA	15.9	
TDS	2.0	mg/L	NA	NA	242	
TOC	0.5	mg/L	NA	NA	4.4	
Alkalinity	2.0	mg/L	NA	NA	145	
Ammonia-Nitrogen	0.2	mg/L	NA	2	0.2	U
Boron	2.5	µg/L	NA	10000	27.5	J
Chlorides	2.0	mg/L	230	250	66.5	
Color	5.0	Pt-Co	NA	NA	30	
Nitrate-Nitrite	0.2	mg/L	10	10	0.2	U
Phenols	0.01	mg/L	NA	0.001	0.01	U
Sulfate	5.0	mg/L	NA	250	30	
Total Hardness as CaCO(3)	2.5	mg/L	NA	NA	195	
Total Kjeldahl Nitrogen	0.5	mg/L	NA	NA	0.5	U
Turbidity	NA	NTUs	NA	NA	NA	
INORGANIC PARAMETERS						
Aluminum	17.4	µg/L	NA	100	66.3	J
Antimony	21.1	µg/L	14	3	23.4	U
Arsenic	1.1	µg/L	190 †	50	1.2	U
Barium	0.7	µg/L	NA	1000	24.7	J
Beryllium	1.1	µg/L	5.3	3	1.2	U
Bromide	1.0	mg/L	NA	2	1	U
Cadmium	2.4	µg/L	1.7 ‡	1.7 ‡	2.7	U
Calcium	10.3	µg/L	NA	NA	67300	
Chromium	2.0	µg/L	321 ‡	50	10.3	U
Cobalt	6.4	µg/L	NA	5	7.1	U
Copper	2.4	µg/L	19 ‡	19 ‡	4.4	J
Cyanide - Total	10	µg/L	5.2	5.2	10	U
Hexavalent Chromium	0.01	mg/L	11	11	0.01	U
Iron	5.2	µg/L	300	300	114	
Lead	0.5	µg/L	5.7 ‡	5.7 ‡	1.4	J
Magnesium	14	µg/L	NA	35000	6640	
Manganese	0.9	µg/L	50	300	366	
Mercury	0.2	µg/L	0.2	0.2	0.2	U
Nickel	12.7	µg/L	144 ‡	144 ‡	14.3	J
Potassium	60.7	µg/L	NA	NA	632	J
Selenium	1.4	µg/L	5	10	1.6	U
Silver	1.9	µg/L	50	50	2.2	J
Sodium	22.8	µg/L	NA	NA	34100	
Thallium	1.1	µg/L	1.7	4	1.2	U
Vanadium	3.1	µg/L	NA	NA	3.4	U
Zinc	1.3	µg/L	150 ‡	300	125	J
ORGANIC PARAMETERS	10	µg/L	-	-	10	U

ABBREVIATIONS
AWQC - Ambient Water Quality Criteria
BOD- Biochemical Oxygen Demand
COD- Chemical Oxygen Demand
NA - Not Applicable
NTUs - Nephelometric Turbidity Units
PT-CO - Platinum Cobalt Standard
TDS- Total Dissolved Solids
TOC- Total Organic Carbon
mg/L= milligrams per liter
µg/L= micrograms per liter

DATA QUALIFERS
J - Estimated value
U - Undetected

NOTES
1) Federal AWQC & NYSDEC AWQS are lowest values of aquatic and human health criteria.
2) Unless noted on table there were no unusual field observations or floaters or sinkers associated with that sample.
† - Value for trivalent arsenic.
‡ - Hardness-dependent criteria uses average water hardness of 171 mg/L calcium carbonate.
366 - Exceeds Water Quality Guidelines.

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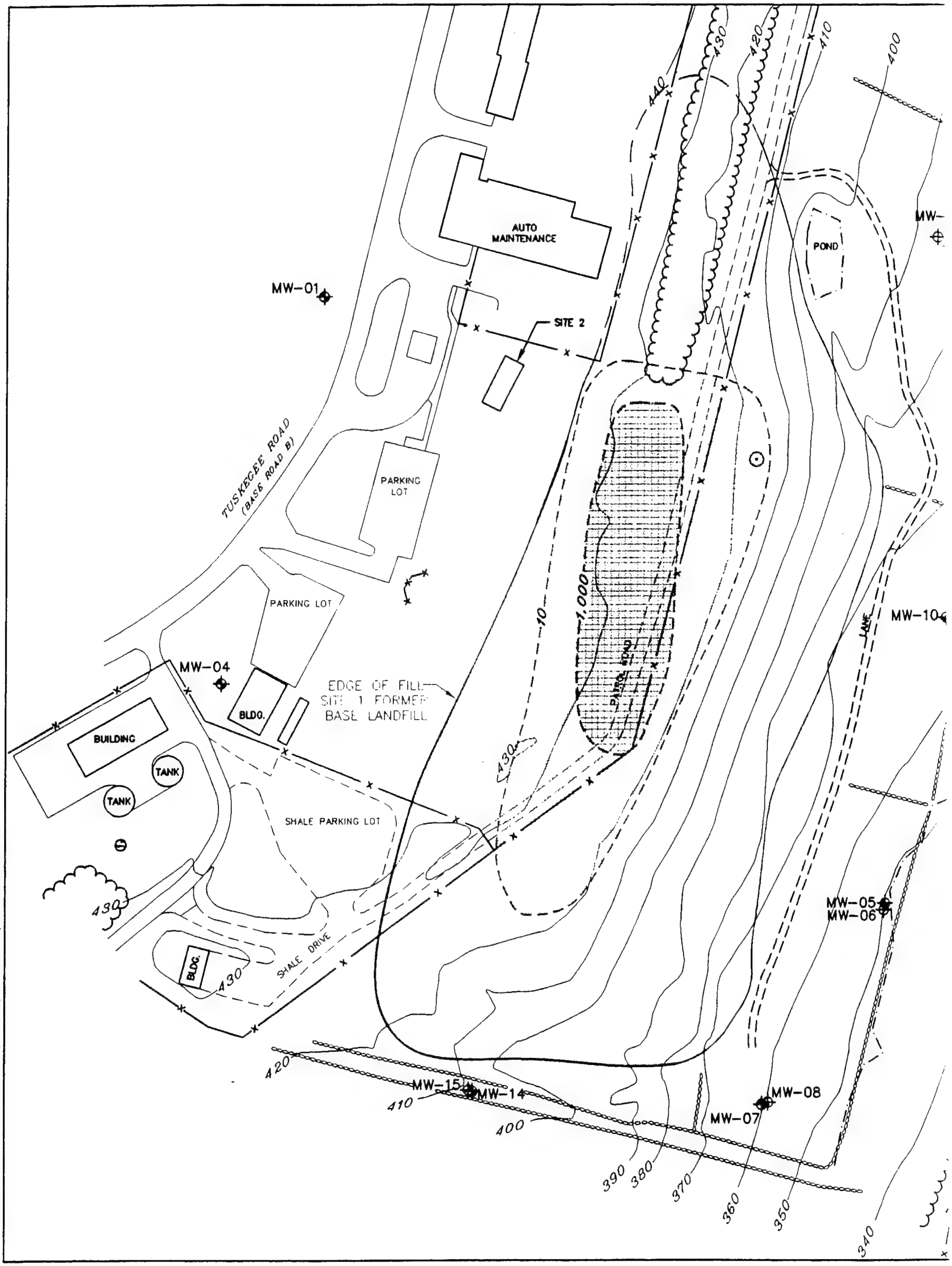

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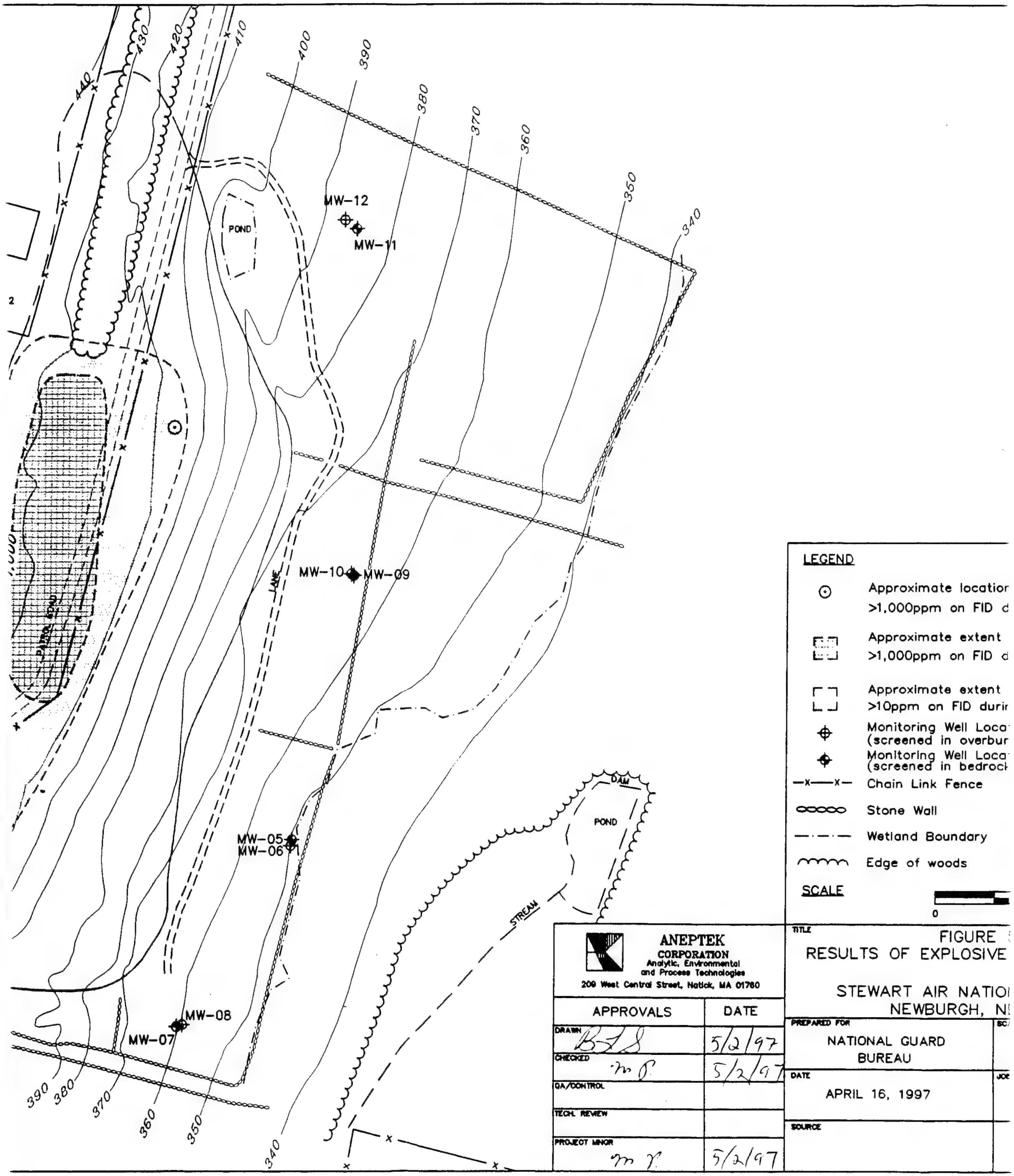
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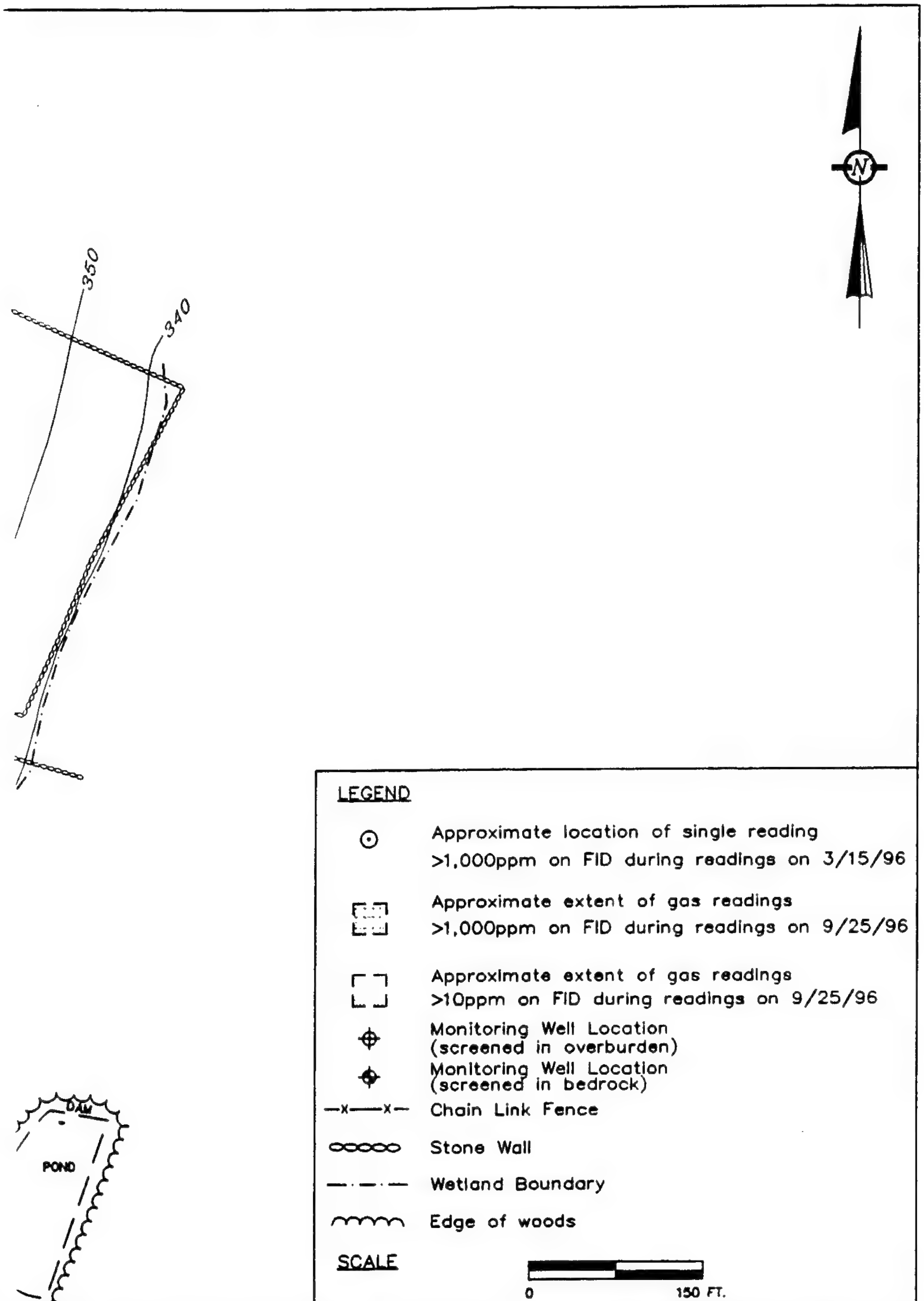

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FIGURE 5–15
RESULTS OF EXPLOSIVE GAS INVESTIGATION

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 16, 1997	JOB NO.
SOURCE	SHEET 1 OF 1

3

into the hole. Each time the instrument reached its maximum concentration, the probe was removed from the hole, allowing the instrument to clear-out, and a reading was taken approximately 4 to 6 inches above the opening of the hole. In general readings did not exceed background above the hole, with the exception of one location, near the southern-most settlement pad, where a concentration of 30 ppm was obtained. After checking the atmosphere above the hole, the FID probe was again inserted into the hole and total VOC concentrations again reached 1,000 ppm. In order to check any effects soil moisture may be having on the FID readings, the measurement procedure was duplicated at a background location well to the north of the landfill. Readings at this location did not exceed background. No readings above background were obtained on the 4-gas meter, with the exception of one slam-bar hole location where an oxygen concentration of 24 percent was noted.

The approximate lateral extent of the area in which elevated readings were obtained on the FID is presented in Figure 5-15. As shown in Figure 5-15, the lateral extent of the area in which total VOC concentrations reached 1,000 ppm is somewhat limited. Concentrations declined sharply as the extent of waste was reached to the west, supporting the conclusion that any gas being generated are migrating vertically upwards through the waste, as opposed to laterally through the subsurface soils. Total VOC concentrations also sharply decreased towards the side slope of the landfill, indicating the less compacted side slope may be acting to vent any gas which may be accumulating under the flatter portions of the landfill.

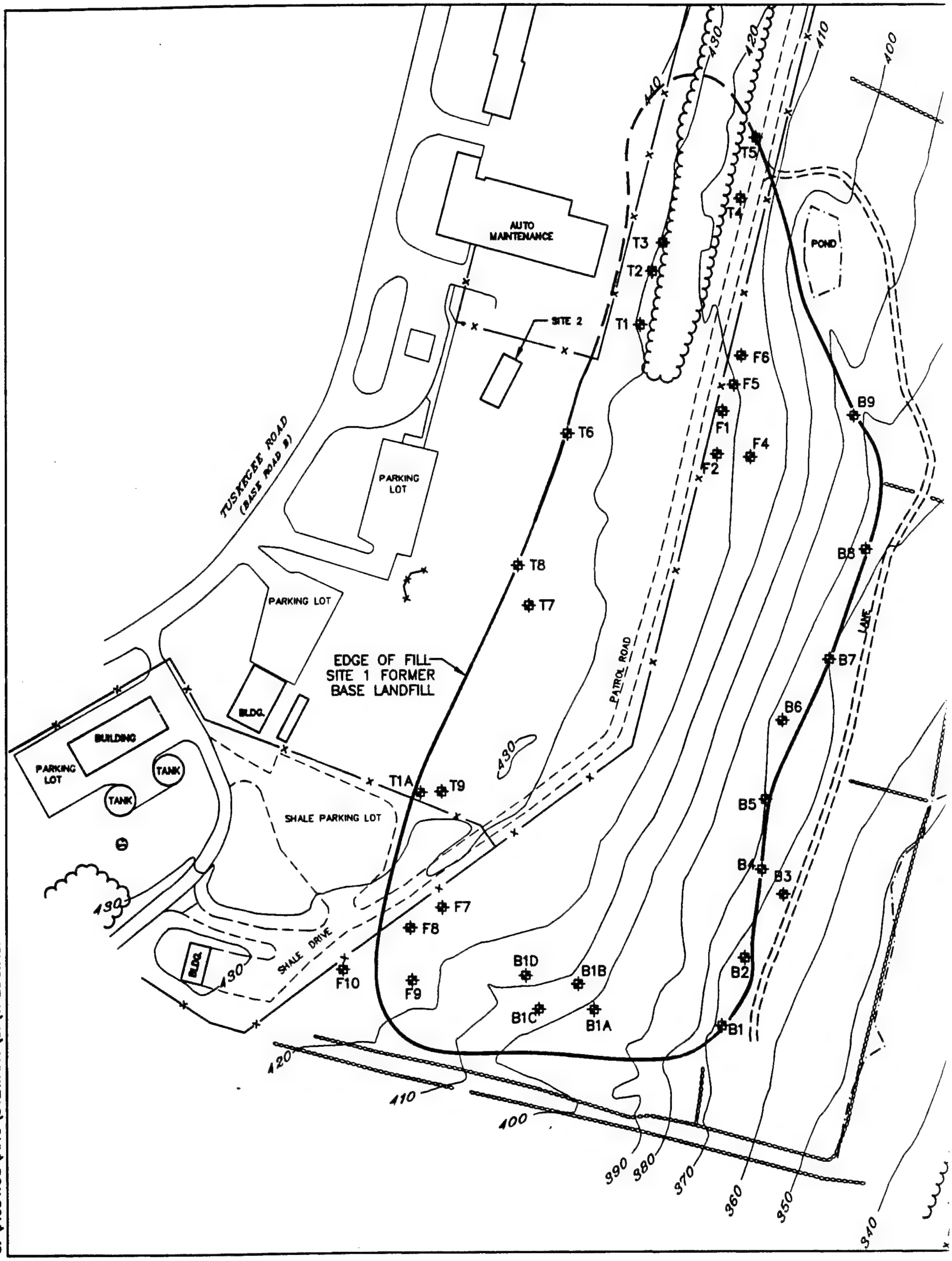
5.3.2 Leachate Investigation Results

After a complete visual inspection of the entire landfill and the area between the landfill and Murphy's Gulch, no instances of any form of liquid discharging to the ground surface in these areas were noted during this reconnaissance. Additionally, no obvious indications of leachate seeps were detected during any of the scheduled monitoring well construction or groundwater and surface water sampling events.

5.3.3 Test Pit Excavation Results

A total of 35 test pits were excavated around and over the fill material. Figure 5-16 presents the interpreted lateral extent of fill material based on the results of test pitting activities. Test pit logs are provided in Appendix C. Test pits were excavated starting on September 19, 1996 through September 21, 1996. Due to the difficulty excavating in several areas around the site the backhoes being used continuously broke down. Each test pit was excavated to a depth of approximately 3 to 5 feet bgs. Once fill material was encountered, the excavation was stopped, and the location marked with a wooden stake. Each stake was labeled to indicate the test pit designation, and was subsequently surveyed by a New York Licensed Surveyor.

In addition to data obtained from each test pit, other physical features of the site were used to develop this lateral extent of fill material. Along the western edge of fill material a good correlation was noted between the edge of fill encountered in test pits and a scarp visible at the ground surface. A small portion of the waste to the north appears to extend beneath the paved



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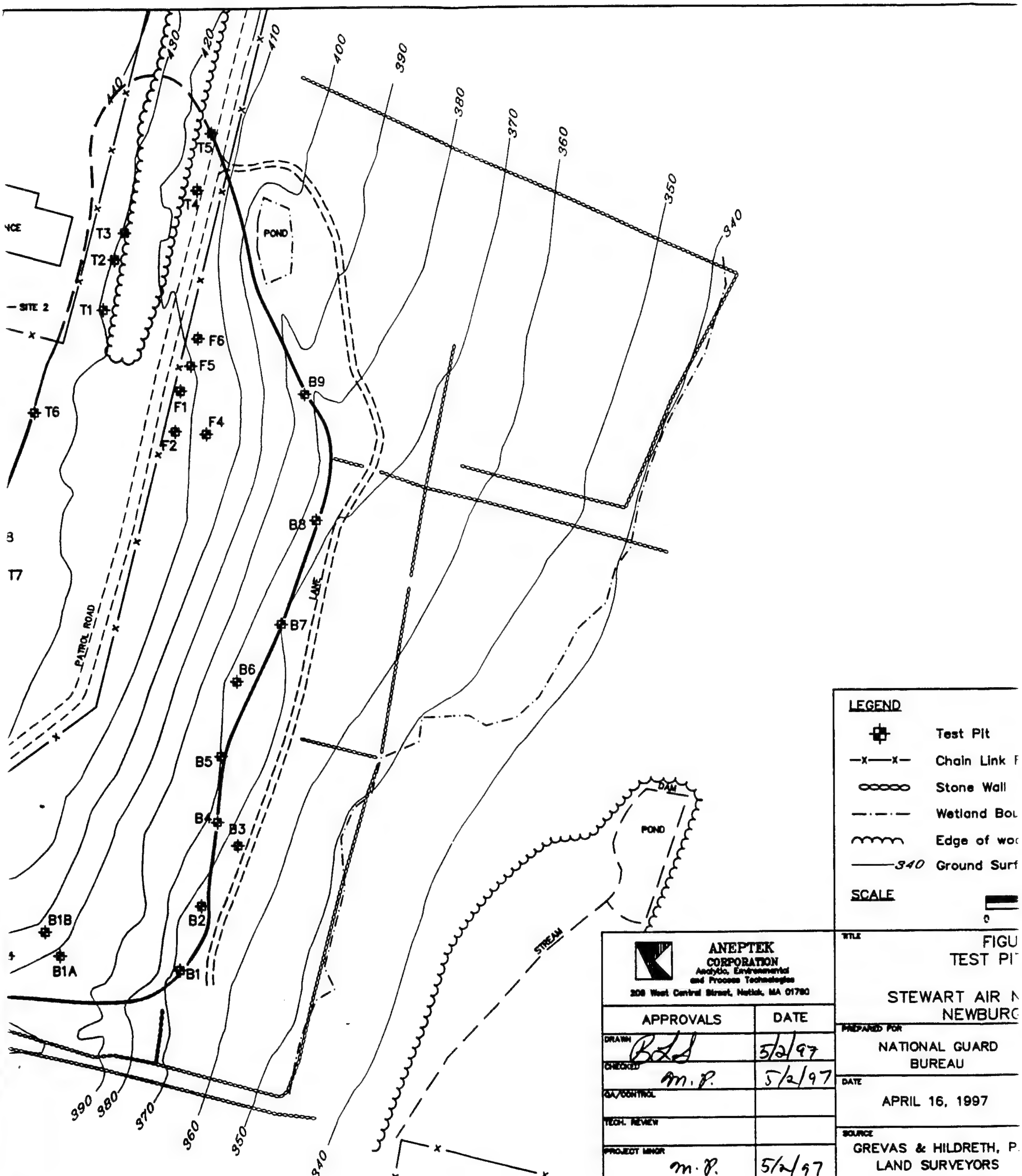

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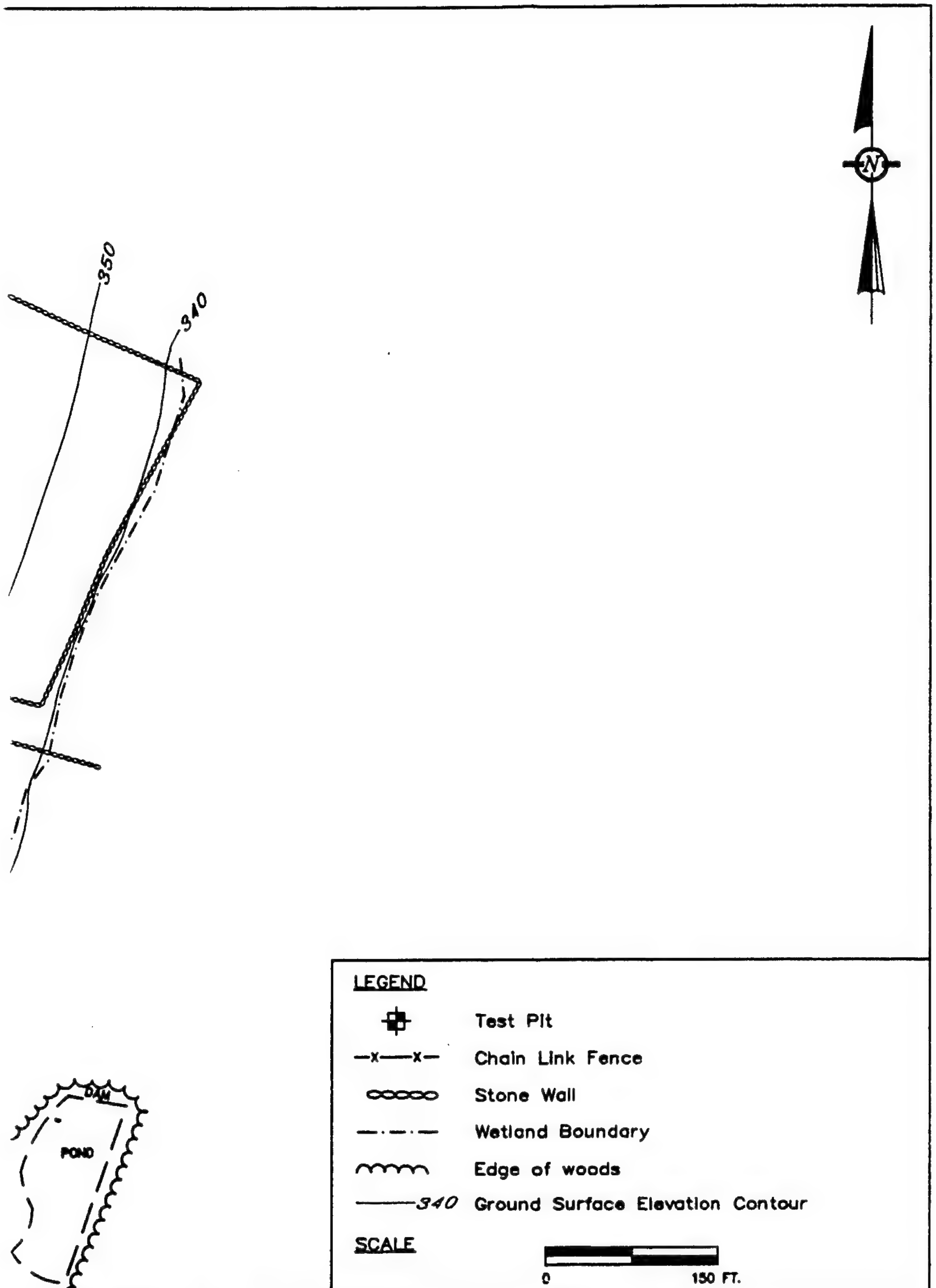

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FIGURE 5–16
TEST PIT LOCATIONS

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 16, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

3

area associated with the Auto Maintenance Facility. Although test pits were not excavated through the pavement, correlation of the test pit results with the SI magnetometer results shows the waste to be present under the pavement. Along the eastern edge of fill material, a correlation was noted between the extent of fill material encountered in the test pits and visual evidence of disturbed ground at the surface. In the southeastern portion of the landfill is a pile of exposed metallic debris, which consists of old desks, refrigerators, and other "white goods". Based on the lateral extent of fill material confirmed during test pit activities, the areal extent of the Site 1 landfill is approximately 8.5 acres.

All wastes encountered during test pitting activities were characteristic of common municipal waste (i.e., soda cans, paper, plastic trash bags, metallic debris). In general, the interim soil cover was found to range in thickness from 1 to 3 feet. A layer of black material was noted in several of the test pits excavated over the flatter portions of the landfill. This layer occurred at depths varying from approximately 2 inches to 2.5 feet and appeared to consist of a burnt material such as a coal ash or slag. This material may have been spread over portions of the landfill as an interim cover after waste disposal activities had ceased. However, no records have been found to substantiate this.

5.3.4 Groundwater Sampling Results

Groundwater samples were collected from monitoring wells MW-01 and MW-04 through MW-12 on November 29 and 30, 1995. Monitoring wells MW-14 and MW-15 were installed during July, 1996 and sampled on August 14, 1996. Soil boring logs and monitoring well construction logs for each of the monitoring wells sampled are provided in Appendices D and E, respectively. Copies of the Chain of Custody forms and the laboratory's Data Summary packages are presented in Appendices H and I, respectively. The overall quality of the groundwater sample analytical data was evaluated for usability. This evaluation is presented in the Data Usability Report provided in Appendix J. Table 5-10 summarizes the groundwater analytical data, showing all compounds detected for each sample. Figure 5-17 presents a summary of the compounds detected in the groundwater samples collected from each monitoring well which exceeded their respective Federal or State drinking water standard and site background.

Inorganic Parameters

Inorganic parameters detected at concentrations greater than their respective drinking water standards include antimony, iron, manganese, sodium and zinc. Antimony was detected in the groundwater sample collected from monitoring well MW-05, and in the duplicate sample. The highest concentration of antimony detected, 44 micrograms per liter (μg/L), may be representative of natural background conditions, as antimony was detected in background monitoring well MW-01 at a similar concentration of 34.1 μg/L.

Iron, manganese, and sodium were the parameters most frequently detected above their respective drinking water concentrations. However, the majority of these exceedances were within the

TABLE 5 - 10
SITE 1 GROUNDWATER ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

					SAMPLE NUMBER											
ANALYTE	DETECTION LIMITS	UNITS	FEDERAL MCL	NEW YORK DWQS[2]	MW-05-113095		MW-15-113095†		MW-06-113095		MW-07-113095		MW-08-113095		MW-09-112995	
FIELD PARAMETERS																
Eh	NA	millivolts	NA	NA	170		170		173		168.4		178.7		146.1	
pH	NA	Std. Units	NA	NA	7.08		7.08		6.7		6.49		6.52		6.6	
Dissolved Oxygen[1]	NA	mg/L	NA	NA	0.54		4.72		0.84		1.19		1.69		0.37	
Field Observations[3]	NA	NA	NA	NA	-		-		BROWN		-		-		GREY	
Floaters or Sinkers	NA	NA	NA	NA	-		-		-		-		-		-	
Specific Conductance	NA	µohms/cm	NA	NA	0.475		0.475		0.651		0.621		0.421		1.57	
Temperature	NA	°C	NA	NA	8.2		8.2		8.2		9		9.4		10.9	
									-		-		-		-	
LEACHATE INDICATORS																
BOD	3.0	mg/L	NA	NA	3	U	3	U	3	U	3	U	3	U	3	U
COD	< 2.0	mg/L	NA	NA	10		8		12		4	U	4		12.0	J
TDS	2.0	mg/L	NA	NA	336		338		300		424		266		764	
TOC	0.5	mg/L	NA	NA	0.5	U	0.5	U	1.9		0.57		1.2		3.4	J
Alkalinity	2.0	mg/L	NA	NA	139		148		178		323		202		646	
Ammonia-Nitrogen	0.2	mg/L	NA	2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Boron	2.5	µg/L	NA	1000	12.9	J	14.2	J	56.2		27.5	J	59.5		88.7	
Chloride	2.0	mg/L	NA	250	83.9		83.9		66.1		39.5		23.1		158	
Color	5.0	Pt-Co	NA	NA	2.5		2.5		5		5		5		10	
Nitrate-Nitrite	0.2	mg/L	NA	10	0.2	U	0.2	U	0.8		0.32		0.7		0.2	U
Sulfate	5.0	mg/L	NA	250	20		19.5		28		42		46		38	
Total Hardness as CaCO(3)	2.5	mg/L	NA	NA	267		246		188		379		223		542	
Total Kjeldahl Nitrogen	0.5	mg/L	NA	NA	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Total Phenols	0.01	mg/L	NA	NA	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Turbidity	-	NTUs	NA	NA	999		999		999		97		324		512	
INORGANIC PARAMETERS																
Aluminum	17.4	µg/L	NA	NA	55.6	J	59.5	J	161	J	92.8		448		617	
Antimony	21.1	µg/L	6	3	36.7	J	44.0	J	23.4	U	23.4	U	23.4	U	23.4	U
Arsenic	1.1	µg/L	50	25	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U
Barium	0.7	µg/L	2000	1000	33.1	J	32.4	J	17.1	J	11.7	J	38.3	J	103	J
Beryllium	1.1	µg/L	4	3	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U
Bromide	1.0	mg/L	10	2000	1	U	1	U	1	U	1	U	1	U	1	J
Cadmium	2.4	µg/L	5	10	2.7	U	4.4	J	5.4	J	4.8		4.3	J	2.7	U
Calcium	10.3	µg/L	NA	NA	84900	J	77600	J	64900	J	120000		74200	J	175000	
Chromium	2.0	µg/L	100	50	13		10.3	U	10.3	U	11.8		10.3	U	10.3	U
Cobalt	6.4	µg/L	NA	NA	7.1	U	7.1	U	7.1	U	7.1	U	7.1	U	7.1	U
Copper	2.4	µg/L	1300	200	4.6	J	6.0	J	9.1	J	2.7	U	7.9	J	3.0	J
Cyanide- Total	10	µg/L	200	100	10	U	10	U	10	U	10	U	10	U	10	U
Hexavalent Chromium	0.01	mg/L	NA	50	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Iron	5.2	µg/L	NA	300	102	J	174	J	317	J	111		770		1520	J
Lead	0.5	µg/L	15	25	0.56	U	1.2	J	1.2	J	1.2		1.5	J	2.3	J
Magnesium	14	µg/L	NA	35000	13500	J	12800	J	6310	J	19200		9190	J	25500	
Manganese	0.9	µg/L	NA	300	709	J	681	J	63.7	J	260		86.7	J	1390	
Mercury	0.2	µg/L	2	2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Nickel	12.7	µg/L	100	NA	14.1	U	14.1	U	14.1	U	14.1	U	14.1	U	15.9	J
Potassium	60.7	µg/L	NA	NA	877	J	817	J	748	J	1190		1470	J	4520	J
Selenium	1.4	µg/L	50	10	1.6	U	1.6	U	1.6	U	1.6	J	1.6	U	1.6	U
Silver	1.9	µg/L	NA	50	3.0	J	3.4	J	5.2	J	4.6	J	5.4	J	2.1	J
Sodium	22.8	µg/L	NA	20000	8960	J	8470	J	49900	J	22500		35500	J	104000	
Thallium	1.1	µg/L	2	4	1.6	J	1.2	U	1.2	J	1.2	J	1.2	J	1.2	J
Vanadium	3.1	µg/L	NA	NA	13.1	J	5.4	J	10.2	J	5.5	J	5.8	J	11.4	J
Zinc	1.3	µg/L	NA	300	86.1	J	31.3	J	121	J	167	J	32.5	J	75.2	J
ORGANIC PARAMETERS																
1,1-Dichloroethane	10	µg/L	NA	5	10	U	10	U	10	U	10	U	10	U	1	J
1,1-Dichloroethene	10	µg/L	7	5	10	U	10	U	2	J	10	U	10	U	10	U
1,1,1-Trichloroethane	10	µg/L	200	5	10	U	10	U	10	U	6	J	2	J	10	U
Acetone	10	µg/L	NA	NA	10	U	10	U	10	U	10	U	10	U	10	U
Carbon Disulfide	10	µg/L	NA	NA	10	U	10	U	10	U	10	U	10	U	1	J
Chloroethane	10	µg/L	NA	NA	10	U	10	U	10	U	10	U	10	U	1	J
Chloroform	10	µg/L	100	7	10	U	10	U	10	U	10	U	10	U	10	U
Methylene Chloride	10	µg/L	NA	5	1	J	10	U	10	U	10	U	10	U	10	U

ABBREVIATIONS
COD- Chemical Oxygen Demand
BOD- Biochemical Oxygen Demand
MCL - Maximum Contaminant Level
mg/L= milligrams per liter
NA - Not applicable
NYSDEC - New York State Department of Environmental Conservation
NTUs - Nephelometric Turbidity Units
PT-CO - Platinum - Cobalt Standard
TOC- Total Organic Carbon
TDS- Total Dissolved Solids
µg/L= micrograms per liter

DATA QUALIFIERS
J - Estimated value
U - Undetected

NOTES
1) In situ dissolved oxygen readings taken 8/14/96.
2) NYSDEC Water Quality Standards and Guidance Values, November 1991.
3) Unless noted on table there were no unusual field observations or floaters or sinkers associated with that sample.
†) Duplicate sample of MW-05
5 -Exceeds water quality guideline.

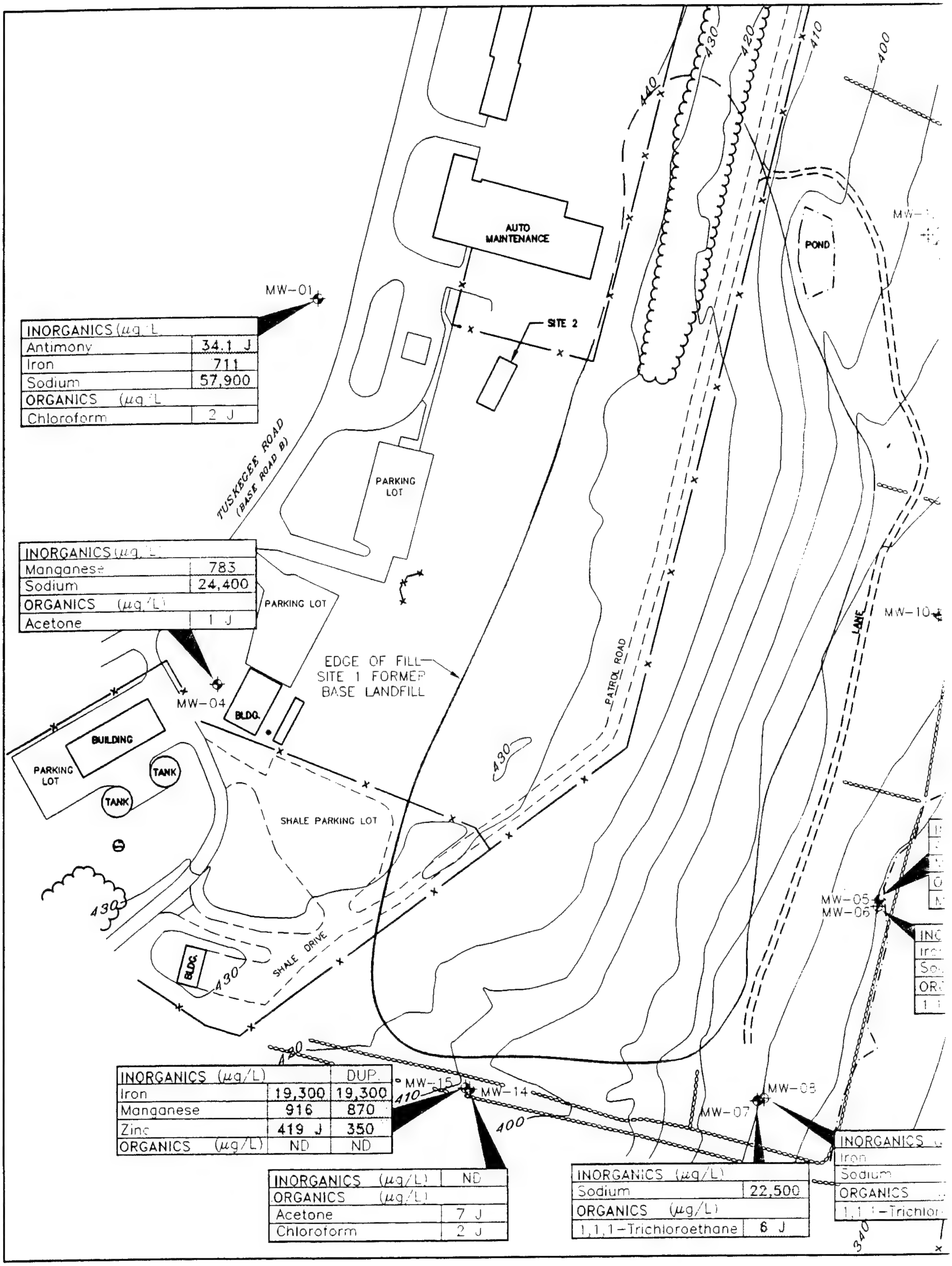
TABLE 5 - 10 (cont.)
SITE 1 GROUNDWATER ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS	UNITS	FEDERAL MCL	NEW YORK DWQS[2]	SAMPLE NUMBER											
					MW-10-112995		MW-11-113095		MW-12-113095†		MW-14-081496		MW-15-081496		MW-25-081496[3]	
FIELD PARAMETERS																
Eh	NA	millivolts	NA	NA	126		179.7		164.5		167		171		171	
pH	NA	Std. Units	NA	NA	6.89		6.59		6.69		8.09		6.25		6.25	
Dissolved Oxygen[1]	NA	mg/L	NA	NA	0.21		0.91		0.63		2.13		4.72		4.72	
Field Observations‡	NA	-	NA	NA	TAN/LT.BN.		-		-		-		-		-	
Floaters or Sinkers	NA	-	NA	NA	-		-		-		-		-		-	
Specific Conductance	NA	µohms/cm	NA	NA	0.922		0.467		0.233		0.277		0.171		0.171	
Temperature	NA	°C	NA	NA	9.9		9.2		7.8		12.7		13.5		13.5	
LEACHATE INDICATORS																
BOD	3.0	mg/L	NA	NA	3	U	3	U	4.2		3	U	3	U	3	U
COD	<2.0	mg/L	NA	NA	16.1	J	4	U	17.9	U	7.5	J	33.8	J	18.8	J
TDS	2.0	mg/L	NA	NA	604		322		184		180		114		116	
TOC	0.5	mg/L	NA	NA	5.0	J	6.3		1.9		1.7		1.7		5.1	
Alkalinity	2.0	mg/L	NA	NA	450		278		86.9		154		38.6		40.6	
Ammonia-Nitrogen	0.2	mg/L	NA	2	0.2	U	0.2	U		R	1	U	1	U	1	U
Boron	2.5	µg/L	NA	1000	65.6		9.6	J	24.2	J	41.8	J	23.1	J	25.6	J
Chlorides	2.0	mg/L	NA	250	98.1		11.6		7.7		4.9		14.7		15.7	
Color	5.0	PT-CO	NA	NA	20		2.5		5		10		15		15	
Nitrate-Nitrite	0.2	mg/L	NA	10	0.3		0.77		0.2	U	0.2	U	0.53		0.59	
Sulfate	5.0	mg/L	NA	250	53		46		31		19		22		22	
Total Hardness as CaCO(3)	2.5	mg/L	NA	NA	294		295		129		177		107		102	
Total Kjeldahl Nitrogen	0.5	mg/L	NA	NA	1.2		0.5	U	0.5	U	0.5	U	1.2		0.5	U
Total Phenols	0.01	mg/L	NA	NA	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Turbidity	NA	NTUs	NA	NA	999		50		999		100		999		999	
INORGANIC PARAMETERS																
Aluminum	17.4	µg/L	NA	NA	1070		59.5	J	460		196	J	9420		9760	
Antimony	21.1	µg/L	6	3	23.4	U	23.4	U	23.4	U	23.2	U	23.2	U	23.2	U
Arsenic	1.1	µg/L	50	25	1.2	U	1.2	U	1.2	U	2.4	U	2.7	J	3.4	J
Barium	0.7	µg/L	2000	1000	44.8	J	11.3	J	18.8	J	13.8	J	72.9	J	81.2	J
Beryllium	1.1	µg/L	4	3	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U
Bromide	1.0	mg/L	10	2000	1	J	1	U	1	U	1	U	1	U	1	U
Cadmium	2.4	µg/L	5	10	3.0	J	2.7	U	2.7	U	4.9	U	4.9	U	4.9	U
Calcium	10.3	µg/L	NA	NA	95100		103000	J	42600		55600	J	32300	J	30600	J
Chromium	2.0	µg/L	100	50	10.3	J	10.3	U	10.3	U	10.6	U	11.9		13.7	
Cobalt	6.4	µg/L	NA	NA	7.1	J	7.1	U	18.7	J	6.3	U	12.5	J	10.1	J
Copper	2.4	µg/L	1300	200	7.2	J	2.7	U	4.3	J	2.9	J	25.7	J	28.3	
Cyanide- Total	10	µg/L	200	100	10	U	10	U	10	U	10	U	10	U	10	U
Hexavalent Chromium	0.01	mg/L	NA	50	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Iron	5.2	µg/L	NA	300	1800	J	81.6	J	698		274		19300		19300	
Lead	0.5	µg/L	15	25	0.56	J	0.87	J	2.3	J	7	J	13.1	J	13.8	J
Magnesium	14	µg/L	NA	35000	13800		9000	J	5530	J	9360		6290		6200	
Manganese	0.9	µg/L	NA	300	122		40.9	J	3370		182		916		870	
Mercury	0.2	µg/L	2	2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.3	
Nickel	12.7	µg/L	100	NA	14.1	U	14.1	U	22.5	J	18	U	21.1	J	25.8	J
Potassium	60.7	µg/L	NA	NA	1200	J	1200	J	774	J	1390	J	2700	J	2850	J
Selenium	1.4	µg/L	50	10	1.6	J	1.6	U	1.8	J	2.2	U	2.2	J	2.2	J
Silver	1.9	µg/L	NA	50	4.7	J	2.8	J	2.1	U	4.9	U	4.9	U	4.9	U
Sodium	22.8	µg/L	NA	20000	128000		17500	J	7520		18000		14900		14900	
Thallium	1.1	µg/L	2	4	1.2	J	1.2	J	1.2	J	1.2	J	1.3	J	0.8	U
Vanadium	3.1	µg/L	NA	NA	6.7	J	6.6	J	4.7	J	7.9	U	25.8	J	26.9	J
Zinc	1.3	µg/L	NA	300	30.5	J	60.7	J	76.5	J	277	J	419	J	350	J
ORGANIC PARAMETERS																
Acetone	10	µg/L	NA	NA	10	U	10	U	3	J	7	J	10	U	10	U
Carbon Disulfide	10	µg/L	NA	NA	10	U	10	U	10	U	10	U	10	U	10	U
Chloroethane	10	µg/L	NA	NA	10	U	10	U	10	U	10	U	10	U	10	U
Chloroform	10	µg/L	100	7	10	U	10	U	10	U	2	J	10	U	10	U
Methylene Chloride	10	µg/L	NA	5	10	U	10	U	10	U	10	U	10	U	10	U
1,1-Dichloroethane	10	µg/L	NA	5	10	U	10	U	10	U	10	U	10	U	10	U
1,1,1-Trichloroethane	10	µg/L	0.2	5	10	U	10	U	10	U	10	U	10	U	10	U

ABBREVIATIONS
COD- Chemical Oxygen Demand
BOD- Biochemical Oxygen Demand
MCL - Maximum Contaminant Level
mg/L= milligrams per liter
NA - Not applicable
NYSDEC - New York State Department of Environmental Conservation
NTUs - Nephlometric Turbidity Units
PT-CO - Platinum - Cobalt Standard
TOC- Total Organic Carbon
TDS- Total Dissolved Solids
µg/L= micrograms per liter

DATA QUALIFIERS
J - Estimated value
R - Rejected value
U - Undetected

NOTES
1) In situ dissolved oxygen readings taken 8/14/96.
2) NYSDEC Water Quality
Standards and Guidance Values, November 1991.
3) Duplicate sample of MW-15.
$ -Exceeds water quality guideline.
†) Sample collected over a two day period due to well going dry.
‡) Unless otherwise noted there were no unusual
field observations or floaters of sinkers associated
with that sample.



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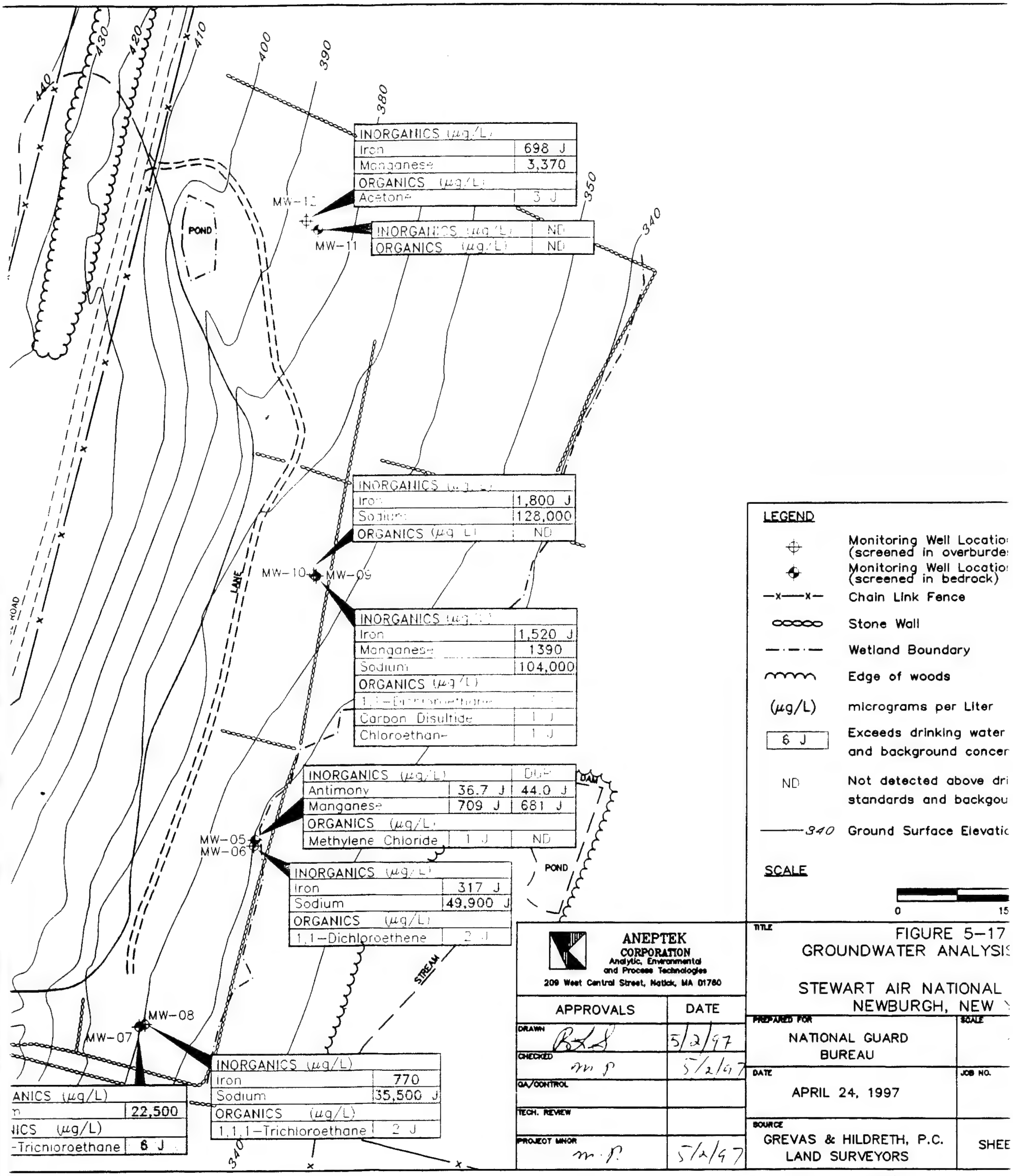
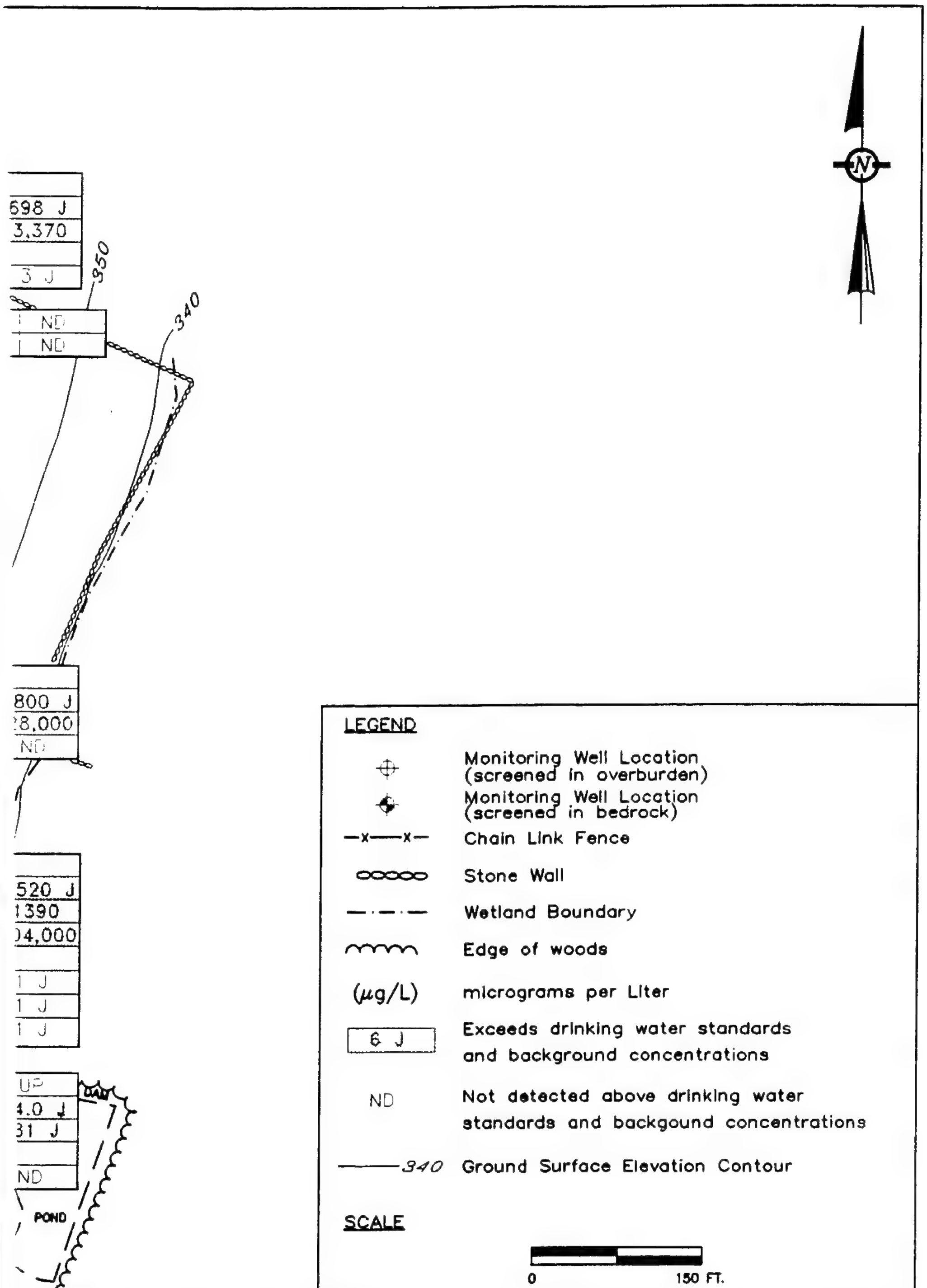


440
430
420
410
400
390
380
350
340
POND
MW-12
MW-11
INORGANICS (µg/L)
Iron 698 J
Manganese 3,370
ORGANICS (µg/L)
Acetone 3 J
INORGANICS (µg/L) ND
ORGANICS (µg/L) ND
MW-10
MW-09
INORGANICS
Sodium 128,000
ORGANICS ND
INORGANICS
Iron 1,520 J
Manganese 1390
Sodium 104,000
ORGANICS
Carbon Disulfide 1 J
Chloroethane 1 J
INORGANICS (µg/L) DUP
Antimony 36.7 J 44.0 J
Manganese 709 J 681 J
ORGANICS (µg/L)
Methylene Chloride 1 J ND
MW-05
MW-06
INORGANICS (µg/L)
Iron 317 J
Sodium 49,900 J
ORGANICS (µg/L)
1,1-Dichloroethene 2 J
LANE
ROAD
DAM
POND
STREAM
MW-08
MW-07
ANICS (µg/L)
n 22,500
NICS (µg/L)
-Trichloroethane 6 J
INORGANICS (µg/L)
Iron 770
Sodium 35,500 J
ORGANICS (µg/L)
1,1,1-Trichloroethane 2 J
340
LEGEND
Monitoring Well Locatio (screened in overburde
Monitoring Well Locatio (screened in bedrock)
Chain Link Fence
Stone Wall
Wetland Boundary
Edge of woods
(µg/L) micrograms per Liter
6 J Exceeds drinking water and background concer
ND Not detected above dri standards and backgou
340 Ground Surface Elevatic
SCALE
0
15
ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
APPROVALS DATE
DRAWN 5/2/97
CHECKED m p 5/2/97
QA/CONTROL
TECH. REVIEW
PROJECT MNGR m. p. 5/2/97
TITLE
FIGURE 5-17
GROUNDWATER ANALYSIS
STEWART AIR NATIONAL
NEWBURGH, NEW
PREPARED FOR
NATIONAL GUARD BUREAU
SCALE
DATE
APRIL 24, 1997
JOB NO.
SOURCE
GREVAS & HILDRETH, P.C. LAND SURVEYORS
SHEE

2



ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760

APPROVALS	DATE
DRAWN B.L.S.	5/2/97
CHECKED m.P.	5/2/97
CONTROL	
TECH. REVIEW	
PROJECT MANAGER m.P.	5/2/97

TITLE
FIGURE 5–17
GROUNDWATER ANALYSIS SUMMARY

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR	SCALE
NATIONAL GUARD BUREAU	1 IN. = 150 FT.
DATE: APRIL 24, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

3

natural background concentrations detected in monitoring wells MW-01 and MW-04. The sample collected from the fractured weathered bedrock well MW-09 was found to contain concentrations of all three of these parameters elevated above both the drinking water standards and background concentrations. The sample collected from the adjacent overburden well MW-10 was also found to contain concentrations of iron and sodium elevated above drinking water standards and background concentrations. In addition to the sample collected from MW-09, the only other detected concentration of manganese above background concentrations was detected in the sample collected from MW-12, of 3,370 μg/L.

The sample collected from MW-15 and its duplicate had concentrations of manganese, sodium, and zinc elevated above both the drinking water standards and background concentrations. The concentration of manganese of 19,300 μg/L was the highest detection of manganese encountered in any sample. This concentration is almost two orders of magnitude greater than that detected in background well MW-01. The detected concentrations of sodium and zinc in the sample from MW-15 were not significantly elevated above background concentrations (i.e., generally less than 1.5 times the background concentration).

Organic Parameters

Several organic parameters were detected in groundwater samples at concentrations ranging from 1 to 7 μg/L. The only detected concentration which exceeded drinking water standards was 1,1,1-trichloroethane (TCA), in the sample collected from MW-07. The concentration of TCA detected in this sample, 6 μg/L only slightly exceeds the New York State Drinking Water Quality Standard of 5 μg/L and is well below the Federal Maximum Contaminant Level (MCL) of 200 μg/L.

5.3.5 Surface Water Sampling Results

Surface water samples were collected from 2 locations within Murphy's Gulch and 1 location within the apparent man-made drainage swale on December 1, 1995. Copies of the Chain of Custody forms and the laboratory's Data Summary packages are presented in Appendices H and I, respectively. The overall quality of the surface water sample analytical data was evaluated for usability. This evaluation is presented in the Data Useability Report provided in Appendix J. Table 5-11 summarizes the surface water analytical data, showing all compounds detected for each sample. Figure 5-18 presents a summary of the compounds detected in the surface water samples collected from each monitoring well which exceeded their respective Federal or State ambient water quality standard or criteria and background concentrations.

Inorganic Parameters

Inorganic parameters detected above their respective criteria or standard include aluminum, iron, manganese, and zinc. Aluminum, detected in sample SW-01 and the duplicate SW-11 at concentrations of 105 μg/L and 130 μg/L, respectively, marginally exceeded the New York State Ambient Water Quality Standard (AWQS) of 100 μg/L. Aluminum was detected in sample

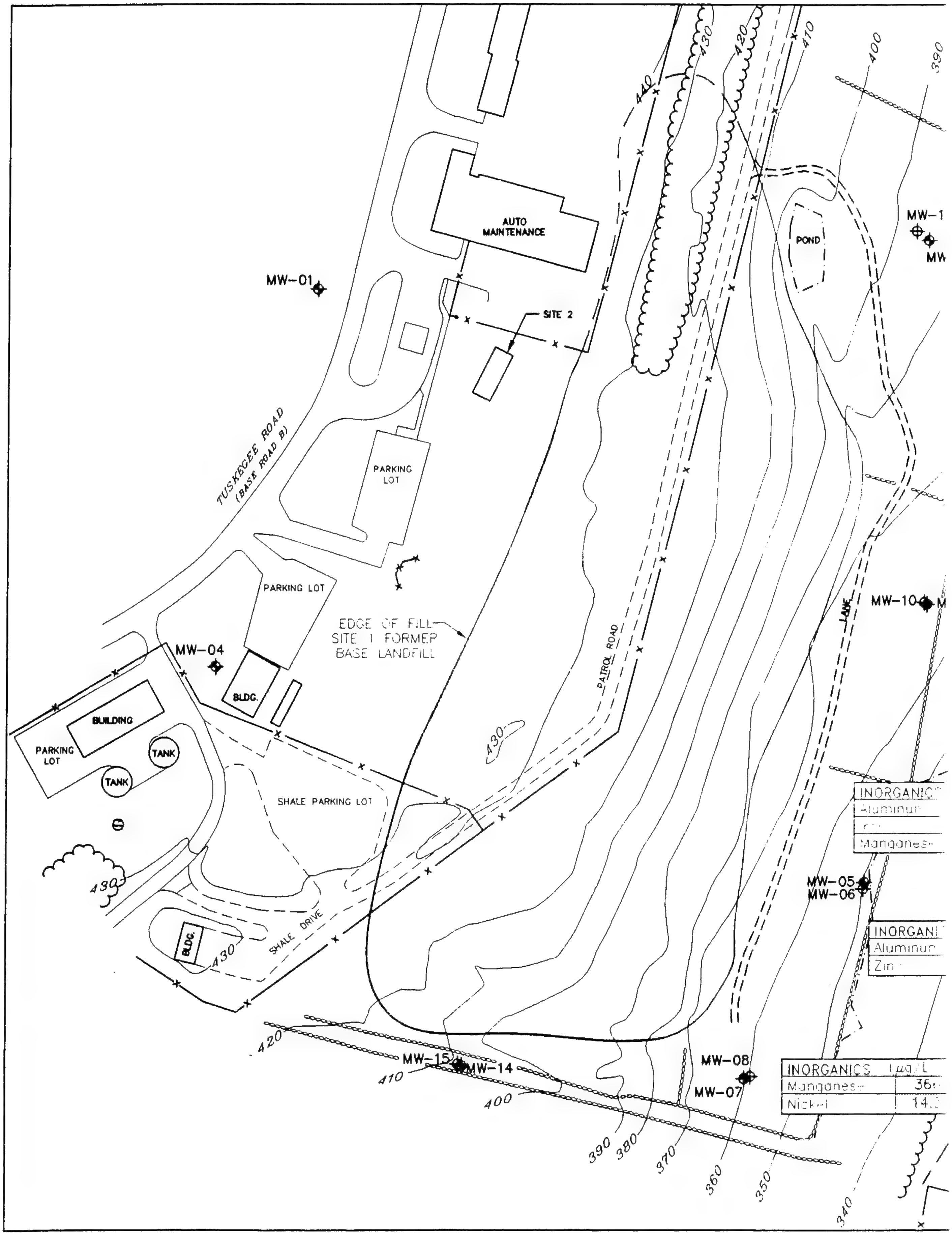
TABLE 5 -11
SITE 1 SURFACE WATER ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS	UNITS	FEDERAL AWQC[1]		NEW YORK AWQS[1]		SAMPLE NUMBER SW-01-120195		SW-11-120195[2]		SW-03 - 120195	
FIELD PARAMETERS												
Dissolved Oxygen	NA	mg/L	NA		> 4.0		13.06		13.06		14.32	
Eh	NA	millivolts	NA		NA		177.3		177.3		186	
Field Observations	NA	NA	NA		NA		-		-		-	
Floaters or Sinkers	NA	NA	NA		NA		-		-		-	
pH	NA	Std. Units	6.5-9		6.5-8.5		NA		NA		6.6	
Specific Conductance	NA	µohms/cm	NA		NA		0.408		0.408		0.246	
Temperature	NA	°C	NA		NA		2.4		2.4		0.6	
LEACHATE INDICATORS												
BOD	3.0	mg/L	NA		NA		3	U	3	U	3	U
COD	< 2.0	mg/L	NA		NA		15.9		9.9		11.9	
TDS	2.0	mg/L	NA		NA		166		220		90	
TOC	0.5	mg/L	NA		NA		3.3		4.7		3.9	
Alkalinity	2.0	mg/L	NA		NA		111		109		82.8	
Ammonia-Nitrogen	0.2	mg/L	NA		2			R		R	0.2	U
Boron	2.5	µg/l	NA		10000		25.2	J	26.0	J	13.6	J
Chlorides	2.0	mg/L	230		250		63.6		64.6		16.4	
Color	5.0	Pt-Co	NA		NA		15		18		17	
Nitrate-Nitrite	0.2	mg/L	NA		10		0.2	U	0.2	U	0.2	U
Phenols	0.01	mg/L	NA		0.001		0.01	U	0.01	U	0.01	U
Sulfate	5.0	mg/L	NA		250		31		31		33.5	
Total Hardness as CaCO(3)	2.5	mg/L	NA		NA		153		167		167	
Total Kjeldahl Nitrogen	0.5	mg/L	NA		NA		0.5	U	0.5	U	0.5	U
Turbidity	NA	NTUs	NA		NA		NA		NA		NA	
INORGANIC PARAMETERS												
Aluminum	17.4	µg/L	NA		100		105	J	130	J	155	J
Antimony	21.1	µg/L	14		3		23.4	U	23.4	U	23.4	U
Arsenic	1.1	µg/L	190	†	50		1.2	U	1.2	U	1.2	U
Barium	0.7	µg/L	NA		1000		17.0	J	18.8	J	23.8	J
Beryllium	1.1	µg/L	5.3		3		1.2	U	1.2	U	1.2	U
Bromide	1.0	mg/L	NA		2		1	U	1	U	1	U
Cadmium	2.4	µg/L	1.7	‡	1.7	‡	2.7	U	2.7	U	2.7	U
Calcium	10.3	µg/L	NA		NA		50400		55100		58400	
Chromium	2.0	µg/L	321	‡	50		10.3	U	10.3	U	10.3	U
Cobalt	6.4	µg/L	NA		5		7.1	U	7.1	U	7.1	U
Copper	2.4	µg/L	19	‡	19	‡	3.9	J	4.0	J	4.8	J
Cyanide - Total	10	µg/L	5.2		5.2		10	U	10	U	10	U
Hexavalent Chromium	0.01	mg/L	11	‡	11		0.01	U	0.01	U	0.01	U
Iron	5.2	µg/L	300		300		347		455		70.0	J
Lead	0.5	µg/L	5.7	‡	5.7	‡	0.96	J	1.6	J	2.0	J
Magnesium	14	µg/L	NA		35000		6540		6990		5020	J
Manganese	0.9	µg/L	50		300		89.6		101		22.4	
Mercury	0.2	µg/L	0.2		0.2		0.2	U	0.2	U	0.2	U
Nickel	12.7	µg/L	144	‡	144	‡	14.1	U	16.7	J	14.1	U
Potassium	60.7	µg/L	NA		NA		356	J	379	J	729	J
Selenium	1.4	µg/L	5		10		1.6	U	1.6	U	2.0	J
Silver	1.9	µg/L	50		50		2.1	U	2.1	U	2.6	J
Sodium	22.8	µg/L	NA		NA		31000		33000		9470	
Thallium	1.1	µg/L	1.7		4		1.2	U	1.2	U	1.2	U
Vanadium	3.1	µg/L	NA		NA		3.4	U	3.4	U	3.4	U
Zinc	1.3	µg/L	150		300		90.0	J	111	J	323	J
ORGANIC PARAMETERS	10	µg/L	-		-		10	U	10	U	10	U

ABBREVIATIONS:
AWQS - Ambient Water Quality Standards
BOD- Biochemical Oxygen Demand
COD- Chemical Oxygen Demand
NA - Not Applicable
NTUs - Nephelometric Turbidity Units
PT-CO - Platinum Cobalt Standard
TDS- Total Dissolved Solids
TOC- Total Organic Carbon
mg/L= milligrams per liter
µg/L= micrograms per liter

DATA QUALIFIERS
J - Estimated value
U - Undetected

NOTES
1) AWQC & NYSDEC AWQS are lowest values values of aquatic and human health criteria
2) Duplicate sample of SW-01-120195.
3) Unless noted on table there were no unusual field observations or floaters or sinkers associated with that sample.
† - Value for trivalent arsenic.
‡ - Hardness-dependent criteria uses average water hardness of 171 mg/L calcium carbonate.
89.6 - Exceeds Water Quality Standards.



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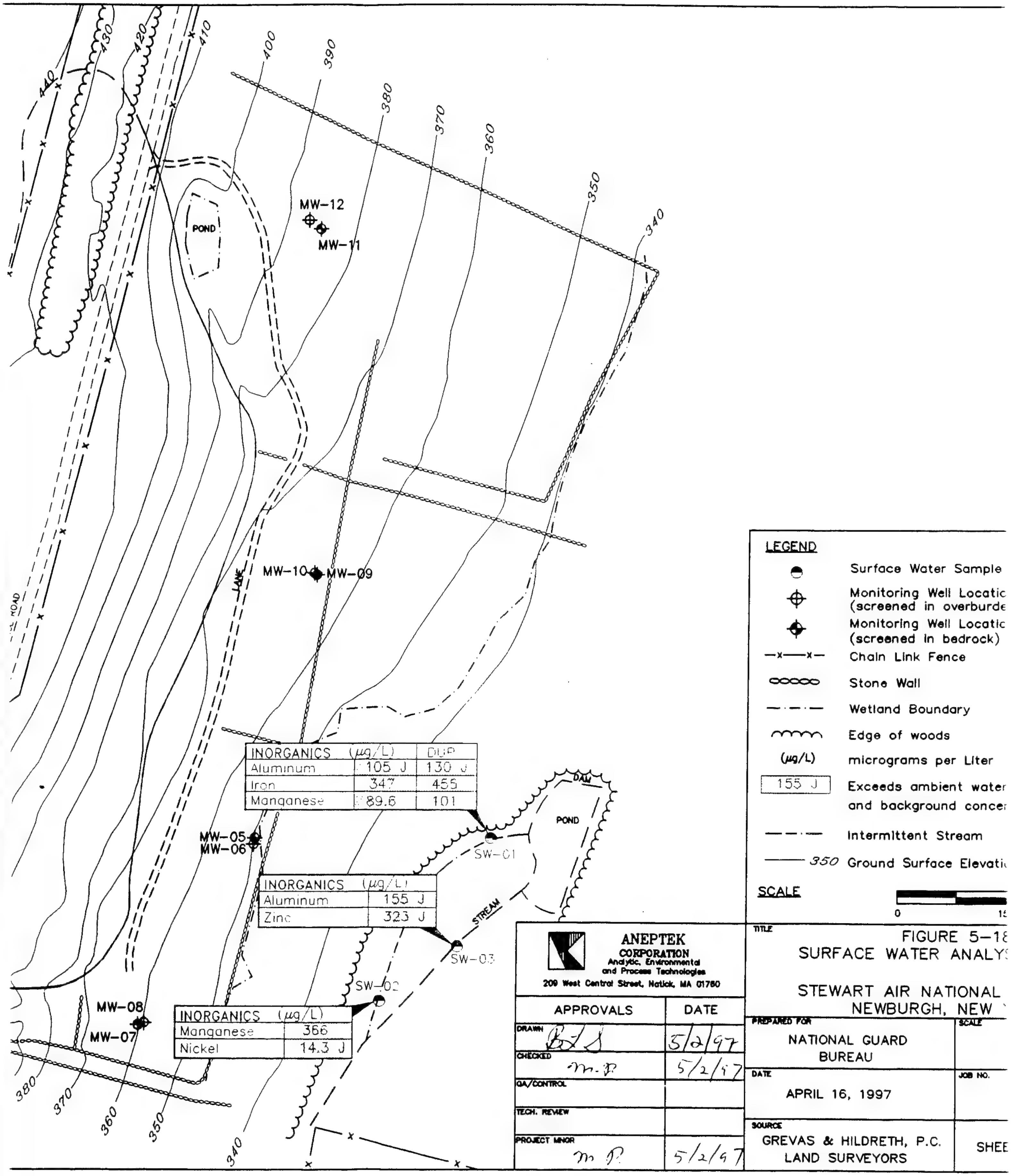
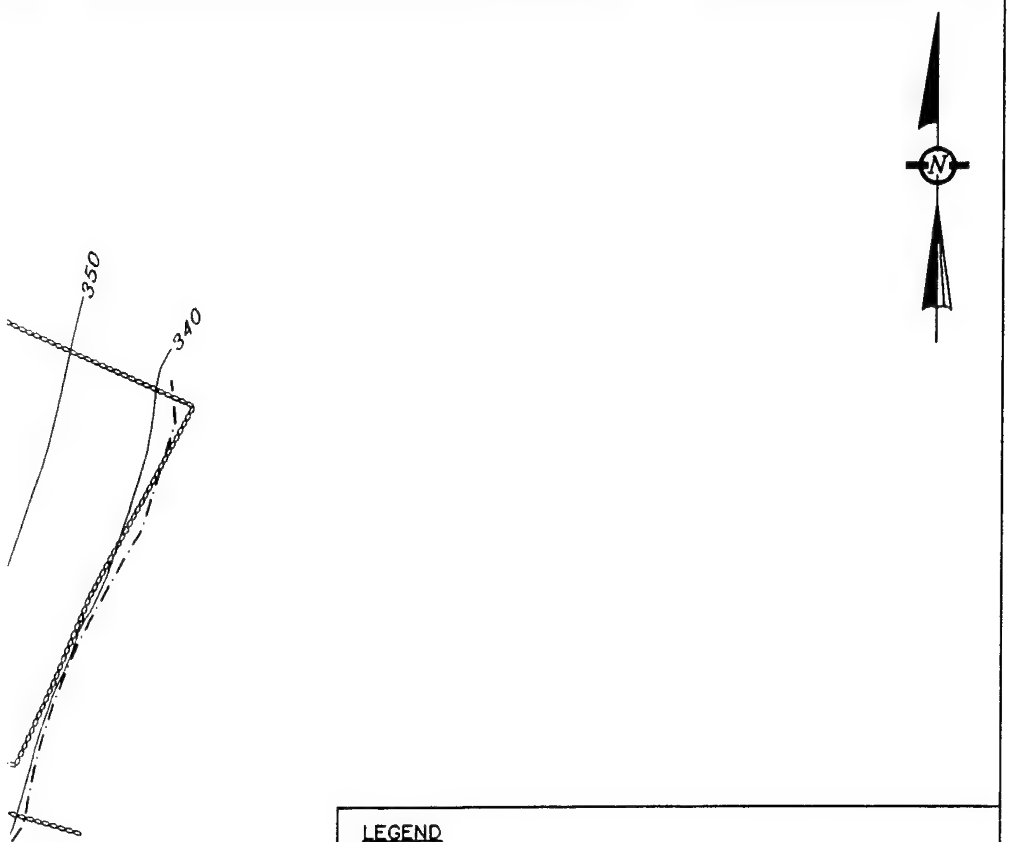


440
430
420
410
400
390
380
370
360
350
340
POND
MW-12
MW-11
MW-10
MW-09
LANE
ROAD
MW-05
MW-06
MW-08
MW-07
DAM
POND
SW-01
SW-03
SW-02
STREAM
INORGANICS (µg/L) DUP
Aluminum 105 J 130 J
Iron 347 455
Manganese 89.6 101
INORGANICS (µg/L)
Aluminum 155 J
Zinc 323 J
INORGANICS (µg/L)
Manganese 366
Nickel 14.3 J
LEGEND
Surface Water Sample
Monitoring Well Locatic (screened in overburde
Monitoring Well Locatic (screened in bedrock)
Chain Link Fence
Stone Wall
Wetland Boundary
Edge of woods
(µg/L) micrograms per Liter
155 J Exceeds ambient water and background concer
Intermittent Stream
350 Ground Surface Elevati
SCALE
0
ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
APPROVALS
DATE
DRAWN
5/2/97
CHECKED
5/2/97
QA/CONTROL
TECH. REVIEW
PROJECT MNGR
5/2/97
TITLE
FIGURE 5-1
SURFACE WATER ANALY
STEWART AIR NATIONAL
NEWBURGH, NEW
PREPARED FOR
NATIONAL GUARD BUREAU
SCALE
DATE
APRIL 16, 1997
JOB NO.
SOURCE
GREVAS & HILDRETH, P.C. LAND SURVEYORS
SHEE

②

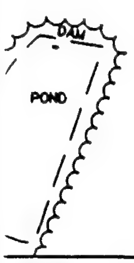


LEGEND

- Surface Water Sample Location
- Monitoring Well Location (screened in overburden)
- Monitoring Well Location (screened in bedrock)
- —x——x— Chain Link Fence
- Stone Wall
- Wetland Boundary
- Edge of woods
- (µg/L) micrograms per Liter
- 155 J — Exceeds ambient water criteria and background concentrations
- Intermittent Stream
- 350 Ground Surface Elevation Contour

SCALE

0 — 150 FT.



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APPROVALS	DATE
B.J.S.	5/2/97
ED m.P.	5/2/97
NTROL	
REVIEW	
CT MNGR m.P.	5/2/97

TITLE
FIGURE 5-18
SURFACE WATER ANALYSIS SUMMARY

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR	SCALE
NATIONAL GUARD BUREAU	1 IN. = 150 FT.
DATE: APRIL 16, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

3

SW-03 at a concentration of 155 μg/L. The only location at which iron was found at a concentration higher the AWQS was at SW-01. The maximum concentration of iron at 455 μg/L, detected in the duplicate sample SW-11, is approximately 1.5 times the AWQS of 300 μg/L. The concentrations of manganese detected in SW-01 and the duplicate SW-11 of 89.6 μg/L and 101 μg/L, respectively, exceed the Federal Ambient Water Quality Criteria (AWQC) of 50 μg/L. However, the upstream manganese concentration of 366 μg/L, detected in sample SW-02, was higher than either of these detections. The concentration of zinc, detected in sample SW-03 of 323 μg/L exceeded both the Federal AWQC of 150 μg/L and the State AWQS of 300 μg/L.

5.3.6 Vector Survey/Wetland Delineation Results

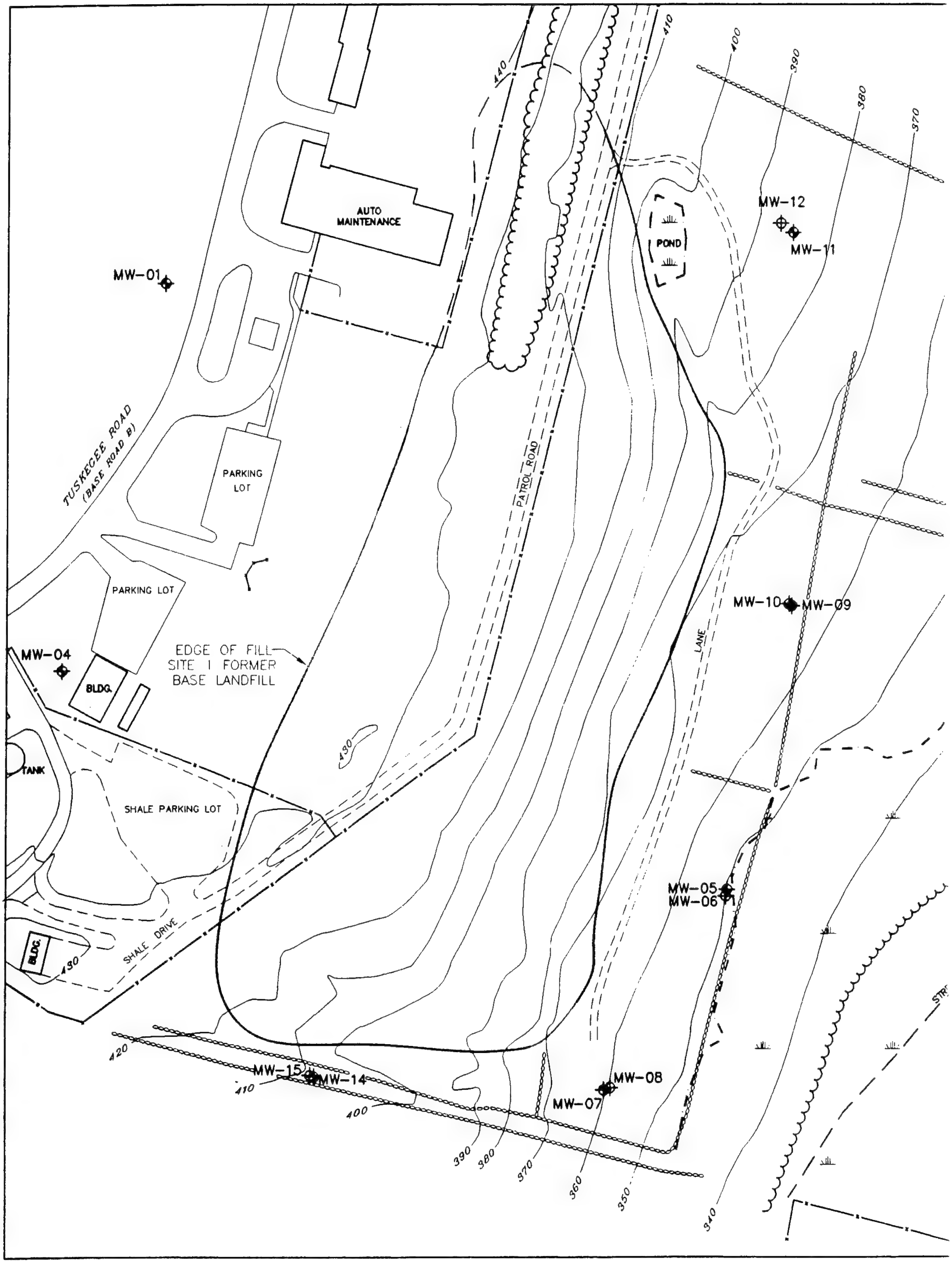
Both the vector survey and the wetland boundary delineation were performed by a field biologist on October 26 and 27, 1995. The results of the vector survey indicated that no significant vector problem exists at the Site 1 landfill. A letter from the field biologist, summarizing the findings during the vector survey is presented in Appendix K. The delineated extent of wetlands at the site are depicted on Figure 5-19.

As noted in Figure 5-19, the footprint of the landfill does not currently infringe on any wetland areas. The small man-made ponded area along the northeastern extent of the waste material was identified as a wetland area. This small wetland may be providing an area for rainwater to collect and subsequently infiltrate into nearby portions of the waste material. Although no significant groundwater contamination was detected during the CI, the potential for infiltration via this wetland area into the waste should not be allowed to continue in the future (i.e., after landfill closure). Also, due to the proximity of this area to the waste material, construction of an engineered landfill cover will impact the wetland.

5.3.7 Slope Stability Evaluation Results

A baseline survey of each of the three slope stability monuments was performed on July 17, 1995. Two subsequent surveying events were performed on October 18, 1995 and July 31, 1996. Tables 5-12 through 5-14 present the calculations and coordinates for each of the slope stability monuments for the first, second and third monitoring events, respectively. As described in Section 4.3.10, the coordinates presented in Tables 5-12 through 5-14 are relative to an arbitrary coordinate system. For each surveying event, the coordinates of each monument were calculated for comparison to the other surveying events.

In reviewing Table 5-12 and 5-13, it must be noted that horizontal distances were measured to different sides of each monument between the first and second surveying events. As a result, comparison of coordinates between the first and second rounds appears to indicate movement of several of the monuments. However, coordinates presented in Table 5-14, based on the third survey event, were taken from the same locations as during the first survey event. A review of all three of tables indicates that for several of the monuments, a false indication of movement has occurred, as coordinates calculated from the third survey event data appear to correspond



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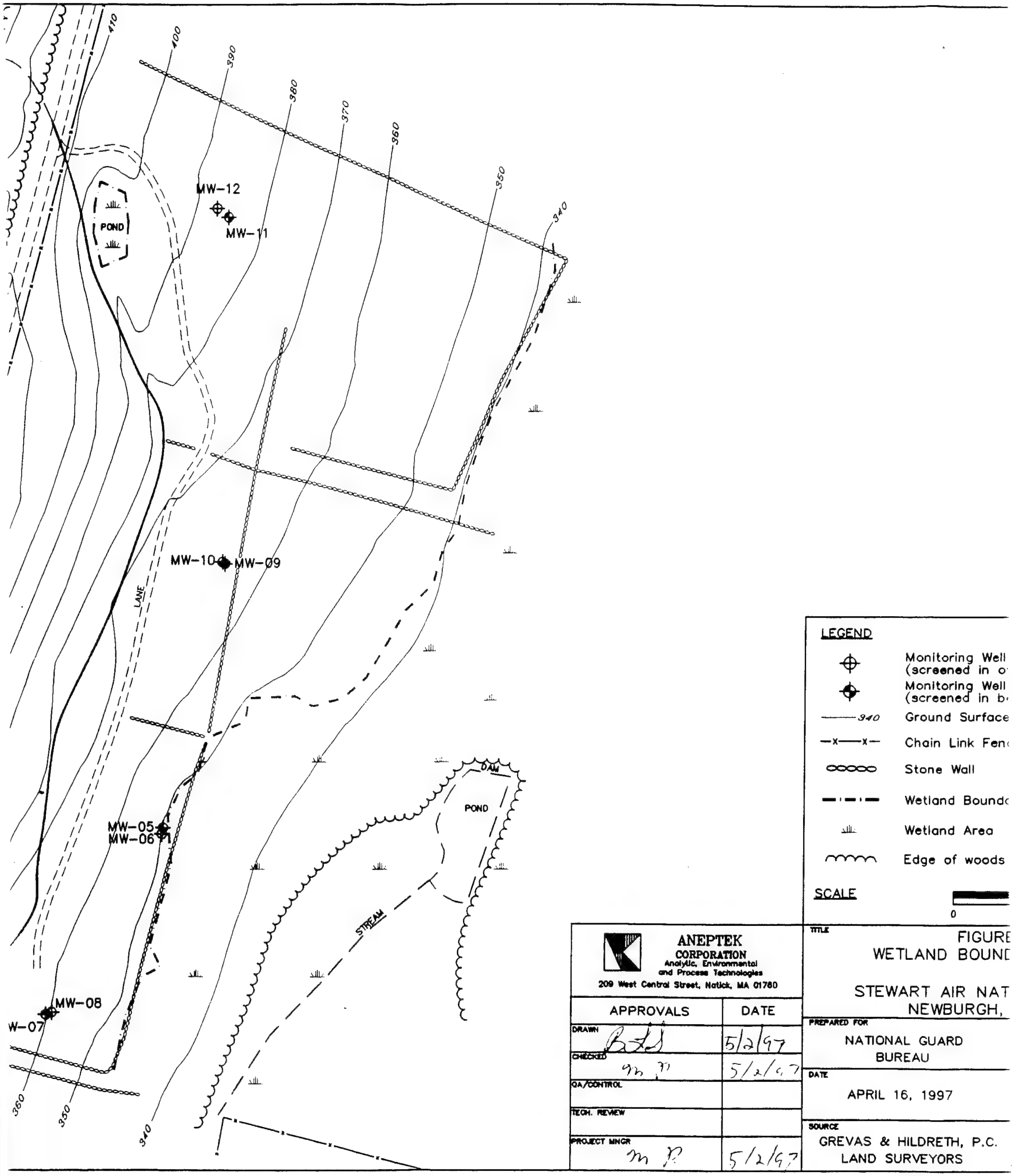
410
400
390
380
370
360
350
340
MW-12
MW-11
POND
MW-10
MW-09
LANE
MW-05
MW-06
MW-08
W-07
DAM
POND
STREAM
360
350
340
LEGEND
Monitoring Well
(screened in o
Monitoring Well
(screened in b
340 Ground Surface
Chain Link Fen
Stone Wall
Wetland Bound
Wetland Area
Edge of woods
SCALE
0
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CORPORATION
Analytic, Environmental
and Process Technologies
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APPROVALS
DATE
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QA/CONTROL
TECH. REVIEW
PROJECT MNGR
5/2/97
TITLE
FIGURE
WETLAND BOUN
STEWART AIR NAT
NEWBURGH,
PREPARED FOR
NATIONAL GUARD
BUREAU
DATE
APRIL 16, 1997
SOURCE
GREVAS & HILDRETH, P.C.
LAND SURVEYORS

2

340

LEGEND

Symbol	Description
	Monitoring Well Location (screened in overburden)
	Monitoring Well Location (screened in bedrock)
340	Ground Surface Elevation Contour
—x——x—	Chain Link Fence
	Stone Wall
	Wetland Boundary
	Wetland Area
	Edge of woods

SCALE

0 150 FT.

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APPROVALS		DATE
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QA/CONTROL		
TECH. REVIEW		
PROJECT MNGR	m. P.	5/2/97

TITLE
FIGURE 5–19
WETLAND BOUNDARY LOCATIONS

STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 16, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

3

TABLE 5 - 12
CALCULATION OF SLOPE STABILITY MONUMENT LOCATION COORDINATES
BASELINE SURVEY -- PERFORMED ON JULY 17, 1995
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

MONUMENT DESIGNATION	REFERENCE POINT	REFERENCE POINT NORTHING	REFERENCE POINT EASTING	BEARING OF BACKSIGHT LINE	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	BEARING OF FORSIGHT LINE	REF. PT. TO MON. LATITUDE	REF. PT. TO MON. DEPARTURE	MONUMENT NORTHING	MONUMENT EASTING
SSM-A3	Pt. 13	581.699	352.746	N 48.80277 W	113.8347	97.368	S 65.03193 W	-41.100	-88.268	540.599	264.478
SSM-B3	Pt. 11	343.700	348.158	N 18.33055 W	101.5556	80.016	S 83.22505 W	-9.439	-79.457	334.260	268.700
Spur A	Pt. 2	0	0	0	45.7889	195.845	N 45.78889 E	136.564	140.377	136.564	140.377
SSM-C2	Spur A	136.564	140.377	N 45.78889 E	225.8917	79.052	S 88.31944 E	-2.318	79.018	134.245	219.395
SSM-C3	Pt. 9	119.947	392.496	N 7.19305 E	89.8556	120.800	N 82.95139 W	14.824	-119.887	134.770	272.609
SSM-D1	Pt.8	-66.262	368.995	N 0.23472 E	88.8167	189.122	S 89.05139 W	-3.131	-189.096	-69.393	179.899
SSM-D2	Pt. 8	-66.262	368.995	N 0.23472 E	91.0458	139.711	N 88.71945 W	3.122	-139.676	-63.139	229.319
SSM-D3	Pt. 8	-66.262	368.995	N 0.23472 E	95.3833	90.861	N 84.38195 W	8.895	-90.425	-57.367	278.571

ABBREVIATIONS
MON. - Monument
PT. - Point
REF. - Reference
SSM - Slope Stability Monument

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TABLE 5 - 13
CALCULATION OF SLOPE STABILITY MONUMENT LOCATION COORDINATES
SECOND ROUND SURVEY -- PERFORMED ON OCTOBER 18, 1995
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

MONUMENT DESIGNATION	REFERENCE POINT	REFERENCE POINT NORTHING	REFERENCE POINT EASTING	BEARING OF BACKSIGHT LINE	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	BEARING OF FORSIGHT LINE	REF. PT. TO MON. LATITUDE	REF. PT. TO MON. DEPARTURE	MONUMENT NORTHING	MONUMENT EASTING
SSM-A3	Pt. 13	581.699	352.746	N 48.80277 W	113.8431	97.642	S 65.04029 W	-41.203	-88.523	540.496	264.223
SSM-B3	Pt. 11	343.700	348.158	N 18.33055 W	101.4556	80.270	S 83.12501 W	-9.609	-79.693	334.091	268.465
Spur A	Pt. 2	0.000	0.000	0	45.7889	195.845	N 45.78889 E	136.564	140.377	136.564	140.377
SSM-C2	Spur A	136.564	140.377	N 45.78889 E	225.8194	79.053	S 88.39171 E	-2.219	79.022	134.345	219.399
SSM-C3	Pt. 9	119.947	392.496	N 7.19305 E	89.7944	121.053	N 83.01251 W	14.726	-120.154	134.673	272.342
SSM-D1	Pt.8	-66.262	368.995	N 0.23472 E	88.7500	189.357	S 88.98472 W	-3.355	-189.327	-69.617	179.668
SSM-D2	Pt. 8	-66.262	368.995	N 0.23472 E	91.0125	140.019	N 88.75278 W	3.048	-139.986	-63.214	229.009
SSM-D3	Pt. 8	-66.262	368.995	N 0.23472 E	95.3097	91.893	N 84.45556 W	8.878	-91.463	-57.383	277.532

ABBREVIATIONS
MON. - Monument
PT. - Point
REF. - Reference
SSM - Slope Stability Monument

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TABLE 5 - 14
CALCULATION OF SLOPE STABILITY MONUMENT LOCATION COORDINATES
THIRD ROUND SURVEY -- PERFORMED ON JULY 29, 1996
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

MONUMENT DESIGNATION	REFERENCE POINT	REFERENCE POINT NORTHING	REFERENCE POINT EASTING	BEARING OF BACKSIGHT LINE	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	BEARING OF FORSIGHT LINE	REF. PT. TO MON. LATITUDE	REF. PT. TO MON. DEPARTURE	MONUMENT NORTHING	MONUMENT EASTING
SSM-A3	Pt. 13	581.699	352.746	N 48.80277 W	113.8472	97.375	S 65.04443 W	-41.084	-88.284	540.615	264.462
SSM-B3	Pt. 11	343.700	348.158	N 20.16694 E	243.0153	79.897	S 83.18222 W	-9.485	-79.332	334.215	268.826
Spur A	Pt. 2	0.000	0.000	S 23.9434 W	200.7139	195.310	N 44.65729 E	138.929	137.276	138.929	137.276
SSM-C2	Spur A	138.929	137.276	N 44.65729 E	228.2292	82.438	S 87.11351 E	-4.151	82.333	134.777	219.610
SSM-C3	Pt. 9	119.947	392.496	N 3.0723 E	93.9361	120.715	N 82.9916 W	14.729	-119.813	134.676	272.683
SSM-D1	Pt.8	-30.773	384.410	N 10.5954 E	69.7083	207.858	S 80.3037 W	-35.009	-204.889	-65.782	179.521
SSM-D2	Pt. 8	-30.773	384.410	N 10.5954 E	67.5722	158.439	S 78.1676 W	-32.488	-155.072	-63.261	229.337
SSM-D3	Pt. 8	-30.773	384.410	N 10.5954 E	65.4236	109.926	S 76.019 W	-26.558	-106.670	-57.331	277.740

ABBREVIATIONS
MON. - Monument
PT. - Point
REF. - Reference
SSM - Slope Stability Monument

more accurately to those calculated from the first event.

It should also be noted that between the second and third survey events, several of the control points were lost due to Base maintenance activities or other reasons. These points were replaced, and the locations of the new control points were surveyed. Although every effort was made to accurately survey all points some inherent error may have been introduced due to the changing of these control points. Therefore, in reviewing the coordinates presented in Tables 5-12 through 5-14, overall trends of movement in the same direction and of approximately the same magnitude were considered to represent real data trends. Instances in which a monument appears to have moved in one direction between the first and second survey events and then in a different direction between the second and third events or where an inordinate displacement appears to have occurred were evaluated in the context of site observations and other data to determine whether or not the data was considered erroneous.

A review of Table 5-12 through 5-14 reveals three observations of interest. First, the slope stability monument C2 appears to have moved to the north continuously between each survey event. Monument C2 appears to have moved a 0.1 feet to the north between the first two survey events and 0.43 feet to the north between the second and third events for a total displacement of approximately 0.53 feet to the north. The greater displacement between the second and third events would be expected due to the construction and loading of the settlement pads and the completion of a full freeze-thaw cycle between these events.

A second observation is the apparent movement of monument D-1. Based on coordinates calculated for the third survey event, this monument appears to have moved to the north 4 feet. This dramatic movement appears somewhat questionable and may be the result of error made in the field. A 4-foot displacement of monument D-1 with no corresponding movement of monuments D-2 and D-3, located approximately 50 feet and 100 feet down slope, respectively would result in obvious disruption of the ground surface (i.e., scarps or mounding). No such observations were made during the third surveying event nor during the third round of explosive gas measurements, during which ANEPTEK personnel walked over the entire side slope to monitor for explosive gas.

The third observation noted is that monument D-3 appears to have moved approximately 1.0 feet to the west between the first and second survey events. This data point is questionable as it would indicate the monument is moving up the side slope and no significant movement was noted for either monument D-2 or D-3 between these events. Also, this monument does not appear to have moved significantly between the second and third survey events, when greater movement would have been expected.

5.3.8 Settlement Characteristics Evaluation Results

Three settlement pads were constructed in November and December, 1995 and a baseline survey was conducted on December 7, 1995, prior to loading the pads. Concrete quarry blocks were loaded onto the settlement pads in accordance with the work plan (ANEPTEK, 1995b) on

December 12, 1995. The settlement pads were surveyed a second time on July 22, 1996, approximately 7 months after being loaded and after one freeze-thaw cycle. Table 5-15 and 5-16 summarize elevation and coordinate calculations for each survey event.

As shown in Table 5-15 and 5-16, no significant vertical settlement appears to have occurred between survey events. Elevations of all survey points were within 0.1 feet between the two survey events, which is considered within an acceptable margin of error for the survey performed. Comparison of the coordinates calculated based on the data obtained during the two survey events appears to indicate limited lateral movement of the settlement pads. However, these observations are considered questionable. As described in Section 5.3.7, several of the control points were lost over the winter and spring months. One of these points was used to set up a backsight line which effected all horizontal angle measurements for the settlement pads. A closer review of the data presented in Tables 5-15 and 5-16 shows a greater degree of change between survey events for points located further from the reference point (i.e., greater horizontal distance). This appears to be consistent with a small difference in the measurement of the horizontal angle. Also, visual inspection of the settlement pads does not indicate any evidence of lateral movement. This change in the backsight line does not effect elevation calculations, which indicate no movement of the settlement pads between survey events.

5.3.9 Side Slope Soil Sampling and Permeability Evaluation Results

Four soil samples were collected from locations over the landfill on July 23, 1996. During the collection of these samples the thickness of the interim cover was found to be approximately 1.5 feet. The soil samples were subjected to grain size analysis by both sieve and hydrometer analysis in accordance with ASTM Method D422. Results of the grain size analyses are presented in Appendix L. The results of the grain size analyses were then used to estimate the intrinsic permeability of the interim soil cover present over the landfill by applying the Fair-Hatch equation (Freeze and Cherry, 1979):

$$k = \frac{1}{A}[(\frac{(1-\phi)^2}{\phi^3})\ (\frac{B}{100}\sum\frac{F}{d_m})^2]^{-1}$$

where: k = intrinsic permeability of the matrix
A = packing factor, experimentally taken as 5.0
ϕ = porosity
B = particle shape factor
F = fraction of sample by weight of each particle size range
d_m = mean particle diameter for each particle size range

TABLE 5 - 15
ELEVATION AND LOCATION CALCULATIONS FOR SETTLEMENT PADS
BASELINE SURVEY-- PERFORMED DECEMBER 7, 1995 - PRIOR TO LOADING
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SETTLEMENT PAD MEASUREMENT POINT	H.I	REFERENCE POINT ELEVATION	BEARING OF BACKSIGHT LINE			HORIZONTAL ANGLE	BEARING OF FORESIGHT LINE			HORIZONTAL DISTANCE	MEASUREMENT PT. COORDINATES		VERTICAL ANGLE	VERTICAL DISTANCE	ELEVATION MEASURMENT POINT
											NORTHING	EASTING			
SP1-1	4.9	92.550	S	22.81705	W	186.2361	N	29.05315	E	371.380	324.649	180.350	90.6125	-3.970	93.480
SP1-2	4.9	92.550	S	22.81705	W	186.7417	N	29.55875	E	365.280	317.739	180.198	90.6194	-3.949	93.501
SP2-1	4.9	92.550	S	22.81705	W	220.9639	N	63.78095	E	156.270	69.041	140.192	91.3736	-3.746	93.704
SP2-2	4.9	92.550	S	22.81705	W	222.3583	N	65.17535	E	150.320	63.111	136.430	91.4042	-3.684	93.766
SP3-1	4.9	92.550	S	22.81705	W	302.1042	S	35.07875	E	77.570	-63.480	44.580	90.6722	-0.910	96.540
SP3-2	4.9	92.550	S	22.81705	W	307.4931	S	29.68985	E	78.760	-68.420	39.010	90.6736	-0.926	96.524

TABLE 5 - 16
ELEVATION AND LOCATION CALCULATIONS FOR SETTLEMENT PADS
SECOND ROUND SURVEY-- PERFORMED JULY 22, 1996 - 7 MONTHS AFTER LOADING
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SETTLEMENT PAD MEASUREMENT POINT	H.I	REFERENCE POINT ELEVATION	BEARING OF BACKSIGHT LINE	HORIZONTAL ANGLE	BEARING OF FORESIGHT LINE	HORIZONTAL DISTANCE	MEASUREMENT PT. COORDINATES		VERTICAL ANGLE	VERTICAL DISTANCE	ELEVATION MEASURMENT POINT
							NORTHING	EASTING			
SP1-1	5	92.550	S 23.9434 W	185.0278	N 28.9712 E	371.508	325.019	179.947	90.6569	-4.259	93.551
SP1-2	5	92.550	S 23.9434 W	185.5278	N 29.4712 E	365.402	318.120	179.773	90.6681	-4.261	93.549
SP2-1	5	92.550	S 23.9434 W	219.7764	N 63.7198 E	156.549	69.314	140.368	91.5042	-4.109	93.701
SP2-2	5	92.550	S 23.9434 W	221.1639	N 65.1073 E	150.437	63.322	136.461	91.5306	-4.018	93.792
SP3-1	5	92.550	S 23.9434 W	300.9236	S 35.133 E	77.608	-63.469	44.662	90.9361	-1.268	96.542
SP3-2	5	92.550	S 23.9434 W	306.2722	S 29.7844 E	78.791	-68.383	39.138	91.0083	-1.387	96.423

As a result of this evaluation the intrinsic permeability of the interim soil cover is estimated to fall between 7.67 x 10^{-9} cm/sec and 2.25 x 10^{-9} cm/sec. These values translate into coefficients of permeability of 5.75 x 10^{-4} cm/sec to 1.68 x 10^{-4} cm/sec for water. Supporting calculations are presented in Appendix K. The Fair-Hatch equation provides a conservatively-high estimate of intrinsic permeability for soils such as those encountered over the Site 1 landfill. Results of the grain size analyses performed on the soil samples collected over the Site 1 landfill indicate a high fraction of clays present in the soils. This is further supported by field observations during and after rainfall events. The Fair-Hatch equation does not account for any swelling of clays which would occur as moisture (i.e., rainfall) enters the matrix. As this swelling occurs, the soil voids are filled, reducing the effective porosity of the matrix and minimizing infiltration into the waste.

5.4 Summary

5.4.1 Geology and Hydrogeology

1. Site 1 is underlain by a layer of very dense silty to clayey lodgement glacial till derived from the underlying bedrock, the shallow portion of which has been weathered to less dense soil. Bedrock immediately underlying the till is composed of weathered, fractured, dark grey shale, whose competency increases with depth. The thickness and extent of fracturing varies with location; however, based on one deep core hole, the thickness is estimated to be approximately 22 feet. A north-south trending fault zone beneath Site 1 is interpreted from the geologic data, near the bottom of the steep slope near Murphy's Gulch.

2. In general, groundwater flow in the study area can be separated into two interconnected flow systems, an upper flow system in the overburden and a lower system in the underlying weathered, fractured shale bedrock. The lodgement till appears to impede vertical flow, especially west of Site 1, where the unweathered portion of the till is very thick (greater than 20 ft).

3. Groundwater flows in both the overburden and bedrock to the east or east-southeast towards lower topographic elevations. In the overburden, groundwater flow lines originating west of Site 1 terminate in the vicinity of Murphy's Gulch. In the bedrock, a southeastern component of flow is interpreted in the southern portion of the study area that is not observed in the overburden. The data indicate that a component of flow in the bedrock that originates west of Site 1 in the vicinity of Site 2 could flow to the southern portion of the study area. In addition, radial flow was observed in the bedrock as indicated by groundwater elevations in the vicinity of Site 2. This may possibly be induced by less dense backfill and surface runoff detention in the pesticide burial area which results in locally increased infiltration, causing a localized "mounding" condition.

4. The waste fill at Site 1 does not appear to be saturated, based on estimates of the water table elevation and projections of the thickness of fill. The disposal history of the landfill

suggests that refuse was simply dumped on existing slopes and not placed in excavations. In addition, no evidence of groundwater or leachate seeps from the landfill or slopes downgradient of the landfill were observed during the leachate investigation. These data support the interpretation that the fill is unsaturated.

5. In most cases, vertical gradients in well pairs were strongly downward (0.1 to 0.01 ft/ft) in the vicinity of Site 2, west of Site 1 and at higher elevations elsewhere in the study area. Gradients remain downwards in well clusters in the eastern portion of the study area that are located more than 140 feet west of the wetlands boundary. Strongly upward gradients (0.1 to 0.01 ft/ft) were observed only at well pairs in the vicinity of the wetlands west of Murphy's Gulch in the southern portion of the study area. Vertical gradients of lesser magnitude were observed in JTB-103 and JTB-107, but were not observed during all water level measurement rounds. Both vertical and horizontal hydraulic gradients exhibited a similar range of values.

6. In the overburden, hydraulic conductivity values range from 0.06 to 1.88 ft/d (2.27×10^{-5} cm/sec to 6.64×10^{-4} cm/sec)) with a geometric mean value of 0.35 ft/d (1.23×10^{-4} cm/sec). In the fractured bedrock, hydraulic conductivity values range from 0.06 to 1.78 ft/d (2.27×10^{-5} cm/sec to 6.29×10^{-4} cm/sec) with a geometric mean value of 0.22 ft/d (7.84×10^{-5} cm/sec). Although hydraulic conductivity values vary throughout the study area, overburden geometric mean hydraulic conductivity values are only slightly higher than bedrock geometric mean hydraulic conductivity. Vertical hydraulic conductivity was not measured in the till overburden; however, because lodgement till is deposited under conditions of very high pressure induced by the overlying glacier ice, vertical hydraulic conductivity values an order of magnitude or higher less than horizontal hydraulic conductivity could be expected in the till.

7. Effective porosity in the overburden is estimated at 1 to 10 percent, based on grain size data from the SI. In bedrock, effective porosity is estimated at 1 to 8 percent, based on fracture density and estimates of fracture aperture width observed in rock cores.

8. In the overburden, average horizontal linear or seepage velocity estimates range from 0.21 to 0.64 ft/d. In the bedrock, estimates range from 0.30 to 2.42 ft/d. The relatively high average horizontal linear velocity estimates are due to both the high horizontal gradient and the relatively low formation effective porosity. Because vertical hydraulic conductivity is likely lower than horizontal hydraulic conductivity by one to two orders of magnitude, corresponding average vertical linear velocity would be correspondingly lower, since both vertical and horizontal hydraulic gradients exhibited similar values.

5.4.2 Explosive Gas Potential

1. Generation of significant amounts of explosive gas does not appear to be ongoing at Site 1. Two rounds of explosive gas measurements failed to indicate the confirmed presence of any areas where explosive gas were detected. A third round of explosive gas

measurements appears to have identified an area of confirmed gas generation. However, this area is limited in lateral extent.

5.4.3 Chemical Characterization Findings

1. No leachate outbreaks were noted during a complete visual inspection of the landfill and downgradient areas, nor during any scheduled field activities.

2. The Site 1 landfill does not appear to be causing any significant adverse impacts to groundwater or nearby surface water quality. Analysis of 12 groundwater and 3 surface water samples failed to show any significant degradation of water quality other than possible impacts from dilute municipal landfill leachate resulting in elevated concentrations of iron, manganese and sodium in the vicinity of wells MW-09 and MW-10. Evidence of dilute municipal landfill leachate was also noted in well MW-15, where elevated concentrations of sodium and nickel, and the highest concentration of manganese were encountered.

5.4.4 Physical Characterization Findings

1. The Site 1 landfill covers an area of approximately 8.5 acres as opposed to the 14 acres estimated during previous investigations.

2. A small portion of the landfill to the north extends under a paved area associated with the nearby Auto Maintenance Facility.

3. A pile of metallic debris is exposed at the surface in the southeastern portion of the landfill.

4. No significant vector problem exists at the Site 1 landfill.

5. The footprint of the landfill does not currently infringe on adjacent wetland areas. However, a small "wetland" area exists adjacent to the landfill along the northeastern extent of waste. This "wetland" is actually a man-made former detention pond.

6. The steep side slope appears to be stable in its present vegetated condition. Three rounds of surveying conducted on 7 slope stability monuments failed to identify any significant movement over the side slope of the fill material. The only movement noted over the year for which these monuments were monitored, appears to be localized to the area of slope stability monument C2.

7. Significant settlement of the landfill waste does not appear to be a major concern for the Site 1 landfill. Construction and loading of the three settlement pads, to a dead load approximately two to three times that of a typical landfill cover, did not produce measurable settlement over a 7 month period which included a full freeze-thaw cycle.

8. The existing interim cover soil appears to be approximately 1.5 feet thick and is currently supporting developed vegetation. This interim cover soil has a relatively low estimated coefficient of permeability, and appears to be acting to minimize infiltration into the waste.

SECTION 6.0

6.0 CONCLUSIONS

Based on the results of the completed CI, the Site 1 landfill appears to be typical of an older municipal landfill which has most likely completed the majority of its gas and leachate generation as well as primary and secondary settlement. The Site 1 landfill does not appear to be causing any current, significant adverse impacts to groundwater or nearby surface water in Murphy's Gulch. Based on these findings, the following conclusions are made:

- Landfill gas mitigative measures will be required as part of an engineered cover for the Site 1. However, due to the limited detections of landfill gas, a passive venting layer with an adequate number of vertical gas vents should provide sufficient mitigation to prevent unacceptable build up of explosive gas.

- The pavement which exists over a small portion of the waste is currently providing a low permeability cover for this waste. Closure design should provide that this area not be altered during landfill cover construction.

- No leachate or groundwater collection or control systems will be required as part of the closure of Site 1.

- The pile of metallic debris exposed at the ground surface in the southeastern portion of the landfill will need to be addressed during the cover design. Local recycling companies should be contacted to evaluate the feasibility of salvaging this material for future use. Should this not be an acceptable option, this material may need to be removed, crushed, and placed back in the landfill.

- Vectors will not need to be addressed during landfill closure.

- Construction of an engineered landfill cover will infringe on the small "wetland" area to the northeast. This will need to be addressed during design of the landfill closure.

- The steep side slope is stable in its current condition, probably due to the presence of heavy vegetation. Should this vegetation be removed for the construction of a landfill cover over the side slope, appropriate measures must be taken to ensure slope stability after closure.

- Settlement of the waste material on a large scale does not appear to be a problem at Site 1. Some limited, localized settlement may occur after placement of an engineered landfill cover. This potential settlement must be considered during design of the cover for Site 1.

- The interim cover currently in place over the landfill is capable of supporting vegetation

and has a relatively low estimated coefficient of permeability. However, this cover does not meet acceptable minimum NYSDEC Part 360 closure specifications. Therefore, additional barrier and cover components will be required as a part of final closure.

SECTION 7.0

7.0 RECOMMENDATIONS

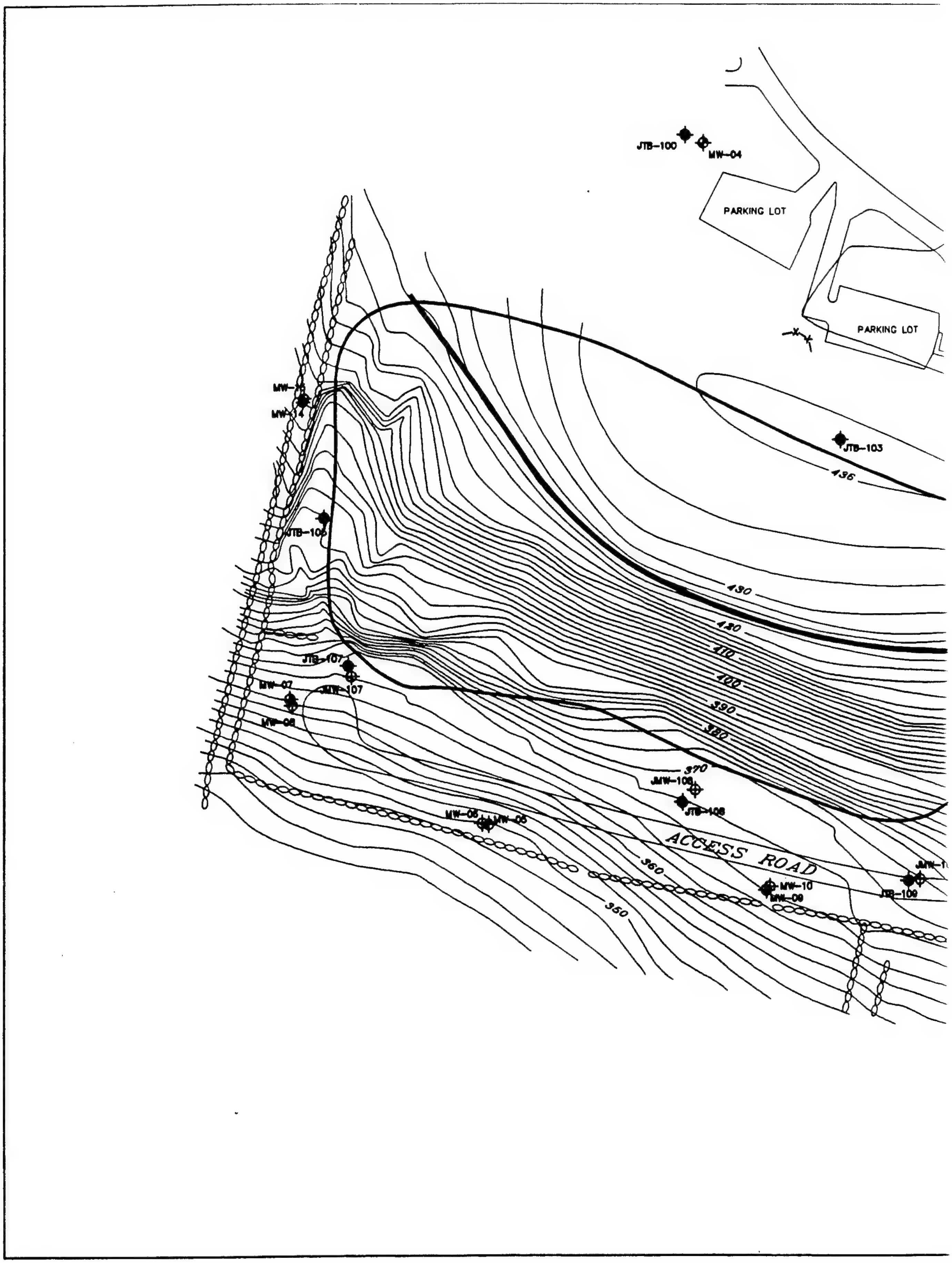
The initial recommendation for the Site 1 landfill was that a modified landfill cover be placed on a portion of the fill material in accordance with the 1988 New York State Part 360 Solid Waste Regulations. Through the application of variances and equivalent design the recommended closure scenario would have included placing an engineered cover over the western, flatter portions of the landfill, and leaving the thick vegetated side slope in its current condition. This scenario is based in the absence of any currently observed significant adverse impact on the surrounding environment. Also, this scenario takes advantage of the stabilizing effect the existing vegetation appears to have on the steep side slope. The Design Analysis Report submitted by ANEPTEK in June of 1996 contains a complete discussion of this recommended cover including the rationale and supporting calculations for leaving the vegetated side slope in its current condition. Even if the side slope is allowed to remain in its current condition, it is recognized that the metallic debris pile present in the southeastern corner of the landfill will need to be addressed. Figure 7-1 presents a preliminary site grading plan for the recommended cover.

Based upon recent conversations with representatives from NYSDEC it appears the approval process for the required variances and equivalent designs may cause significant delays in completing the design of the landfill closure. Also, it does not appear likely that the required approvals will be granted by NYSDEC, based on recent precedents set at other apparently similar landfill sites. Therefore, in the interest of avoiding significant project schedule delays it is recommended that a New York State geomembrane cover be placed over the entire landfill, with the exception of a small area already covered by a low permeability layer (asphalt).

Given the desired future use of the site (i.e., as a recreational softball field) it is further recommended that an equivalent design be requested, replacing the 12-inch gas venting layer with a geonet/geosynthetic fabric composite layer. This will reduce the amount of additional fill required to provide the relatively flatter ground surface slope required for a ballfield. In order to allow any landfill gas present to vent to the atmosphere, vertical gas vents must be installed at a minimum of one vent per acre in accordance with the New York State Part 360 regulations. Based on conversations with NYSDEC representatives, this equivalent design should be acceptable to the regulators. Figure 7-2 presents a preliminary site grading plan for the New York State geomembrane cover. Figure 7-3 presents a typical cross sectional view of a New York State geomembrane cover.

Long term monitoring of both landfill gas and groundwater at Site 1 is required. Landfill gas monitoring is required on a quarterly basis at each of the vertical gas vents as well as all nearby storm drains, culverts, and catch basins. Groundwater monitoring will consist of quarterly groundwater sampling from monitoring wells MW-01, MW-04 through MW-12, MW-14, and MW-15. These samples must be analyzed annually for the Baseline Parameters listed in 6 NYCRR Part 360-2.11 and quarterly for the Routine Parameters listed in 6 NYCRR Part 360-

2.11. NYSDEC may approve one of two standard variances which reduces these requirements. This issue will be addressed upon completion of NYSDEC's review of this CI report.



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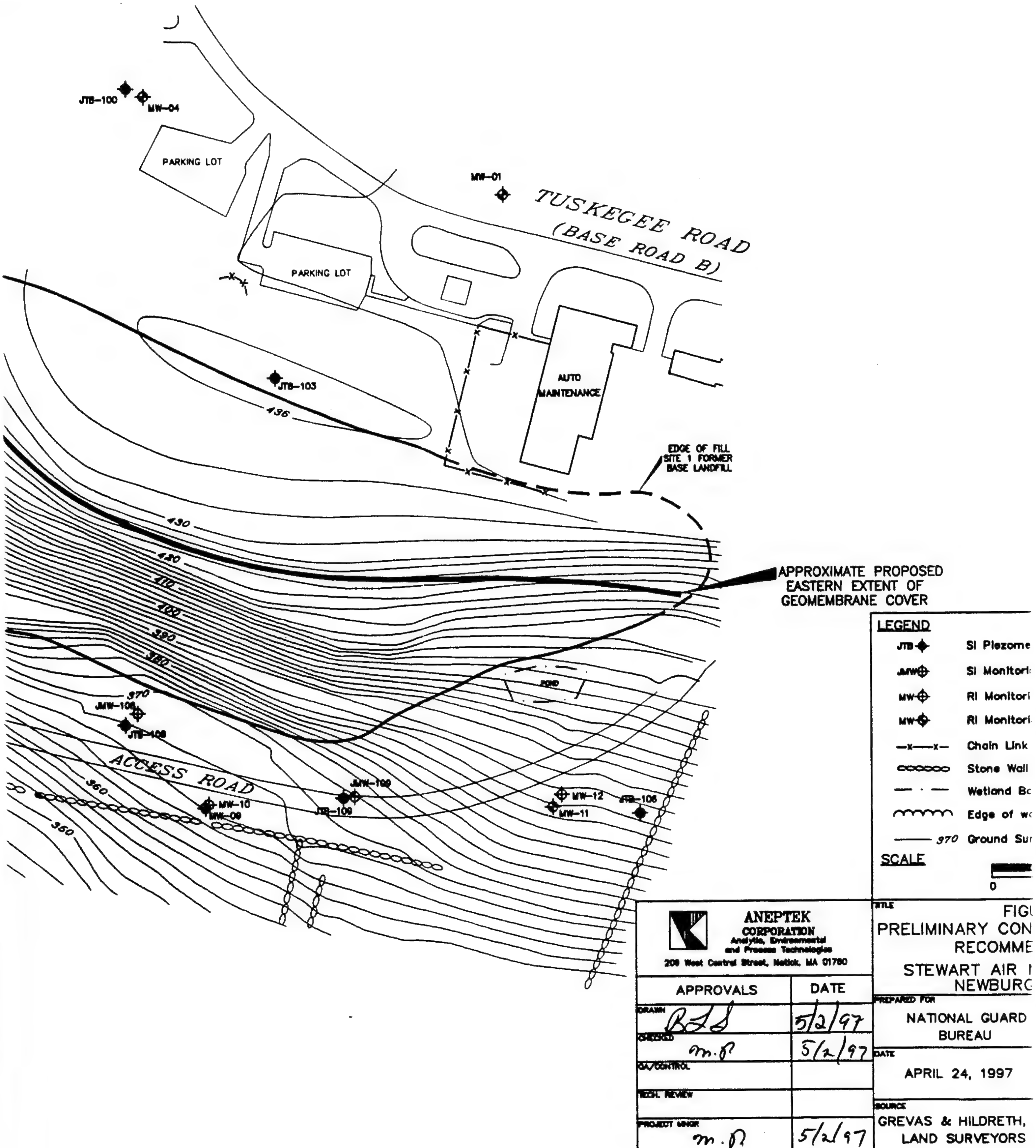

JTB-100
MW-04
PARKING LOT
MW-01
TUSKEGEE ROAD
(BASE ROAD B)
PARKING LOT
JTB-103
AUTO MAINTENANCE
436
EDGE OF FILL SITE 1 FORMER BASE LANDFILL
430
420
410
400
390
380
370
APPROXIMATE PROPOSED EASTERN EXTENT OF GEOMEMBRANE COVER
POND
JMW-108
JTB-108
ACCESS ROAD
360
350
MW-10
MW-09
JMW-109
JTB-109
MW-12
MW-11
JTB-106
LEGEND
SI Piezome
SI Monitori
RI Monitori
RI Monitori
Chain Link
Stone Wall
Wetland Bc
Edge of w
370 Ground Sur
SCALE
0
ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
209 West Central Street, Natick, MA 01760
APPROVALS
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SOURCE
GREVAS & HILDRETH, LAND SURVEYORS

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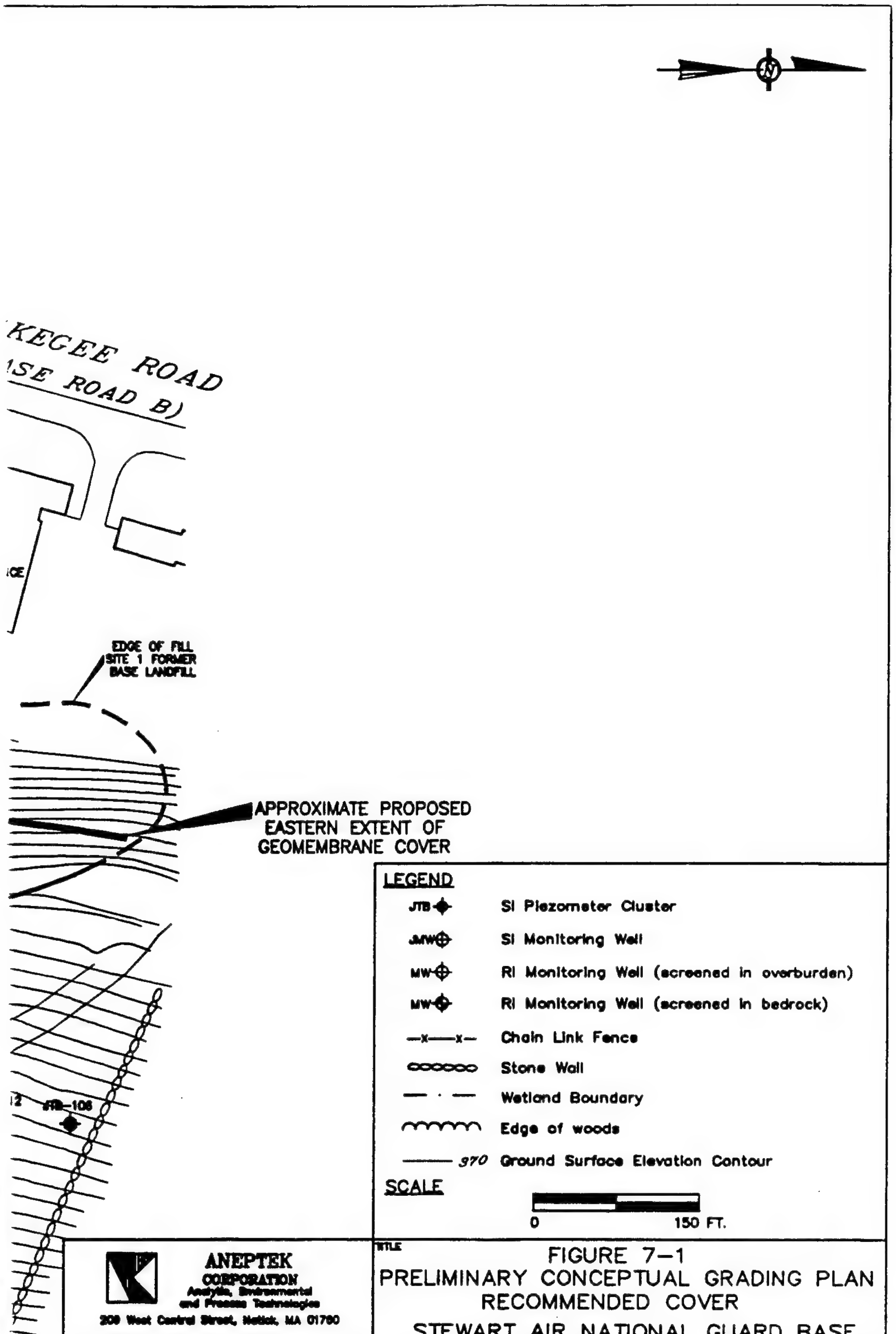

LEGEND

JTB	SI Piezometer Cluster
JMW	SI Monitoring Well
MW	RI Monitoring Well (screened in overburden)
MW	RI Monitoring Well (screened in bedrock)
—x—x—	Chain Link Fence
	Stone Wall
— · —	Wetland Boundary
	Edge of woods
—— 370	Ground Surface Elevation Contour

SCALE

0 150 FT.

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TITLE
FIGURE 7–1
PRELIMINARY CONCEPTUAL GRADING PLAN
RECOMMENDED COVER
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

APPROVALS		DATE
DRAWN	BJS	5/2/97
CHECKED	m.R	5/2/97
QA/CONTROL		
TECH. REVIEW		
PROJECT MNGR	m.R	5/2/97

PREPARED FOR: NATIONAL GUARD BUREAU	SCALE: 1 IN. = 150 FT.
DATE: APRIL 24, 1997	JOB NO.
SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

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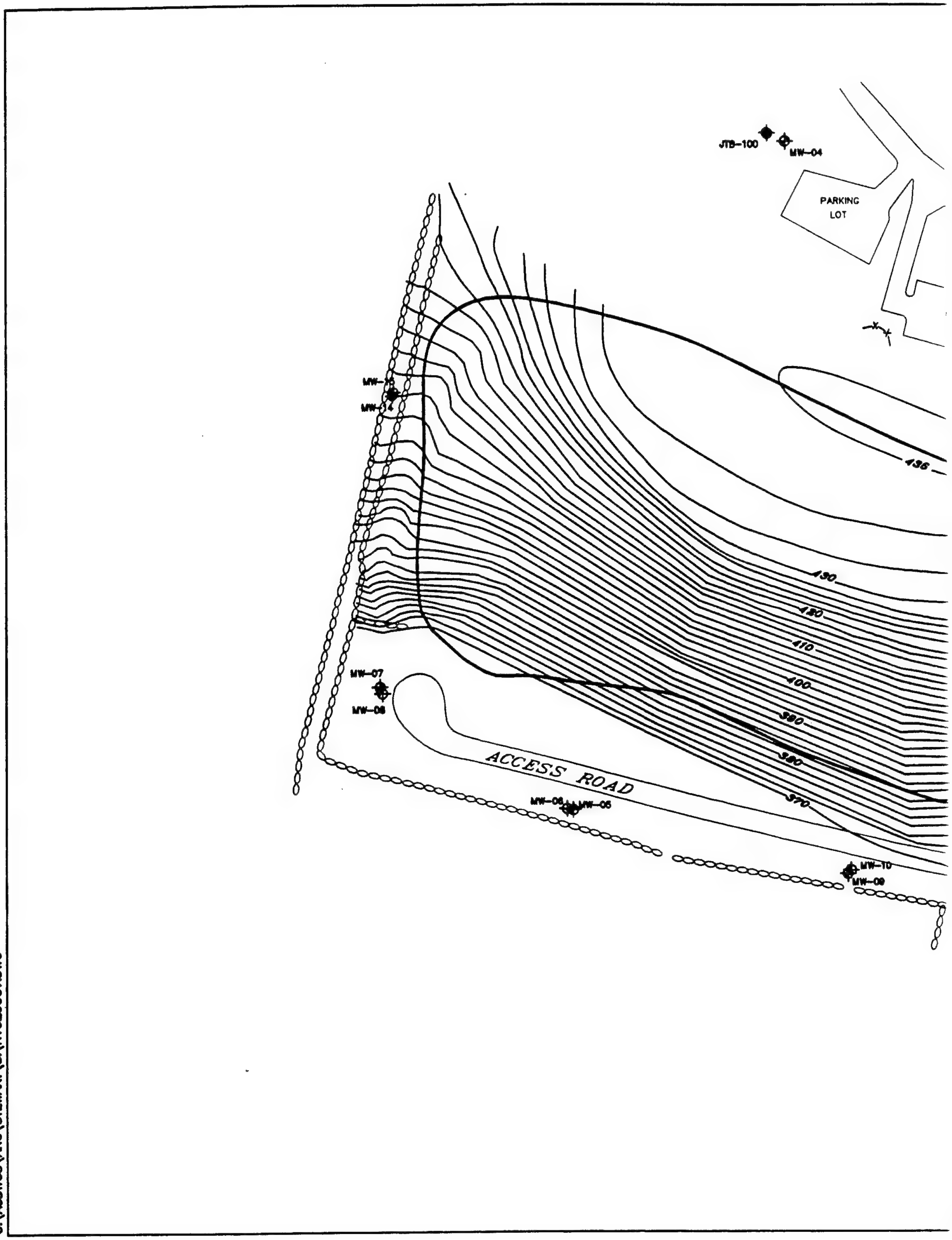

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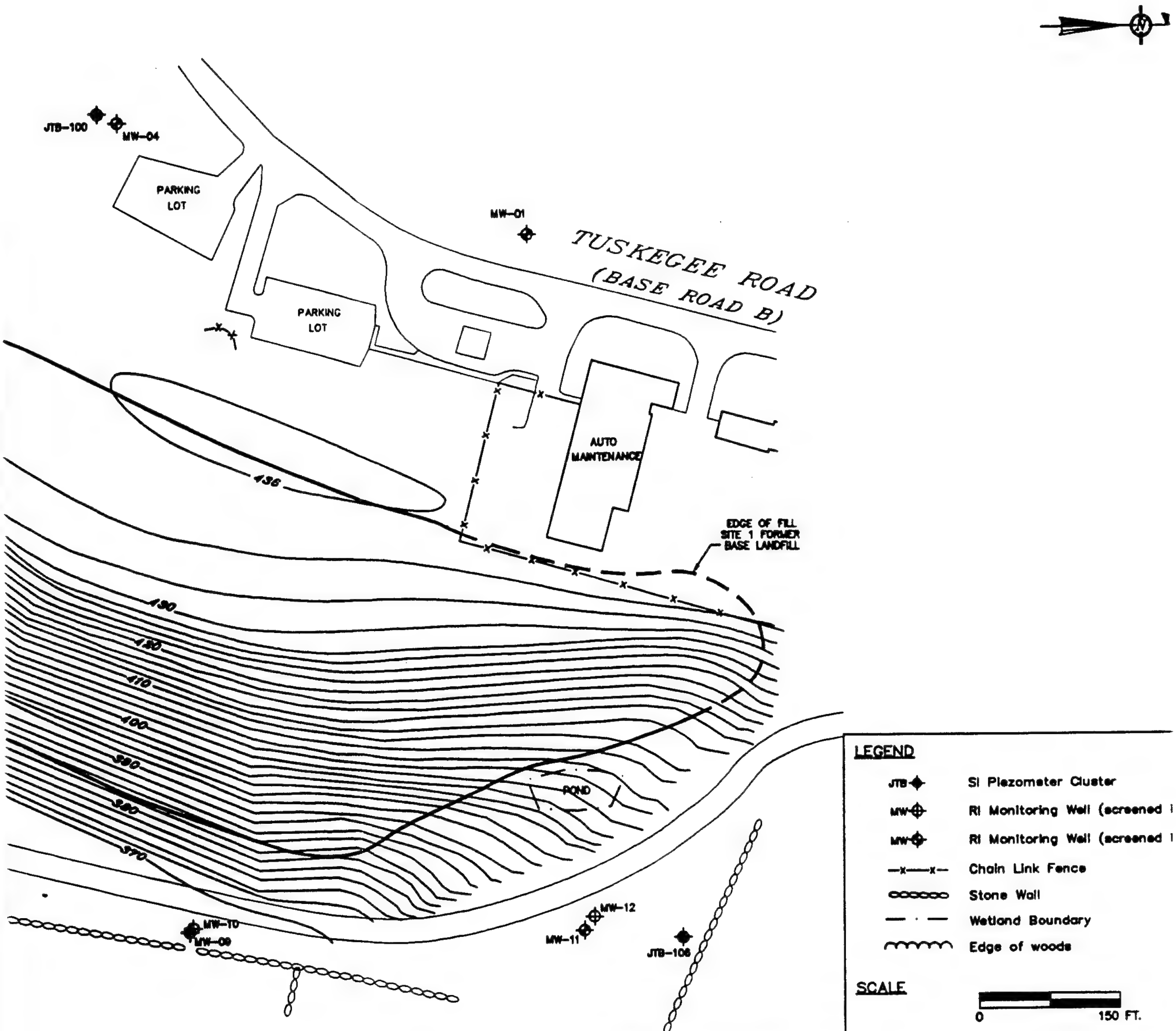

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TITLE
FIGURE 7–2
PRELIMINARY CONCEPTUAL GRAI
NEW YORK STATE GEOMEMBRA
STEWART AIR NATIONAL GUAF
NEWBURGH, NEW YORK

APPROVALS	DATE
DRAWN B.S.S.	5/2/97
CHECKED M.P.	5/2/97
QA/CONTROL	
TECH. REVIEW	
PROJECT MNGR M.P.	5/2/97

PREPARED FOR: NATIONAL GUARD BUREAU

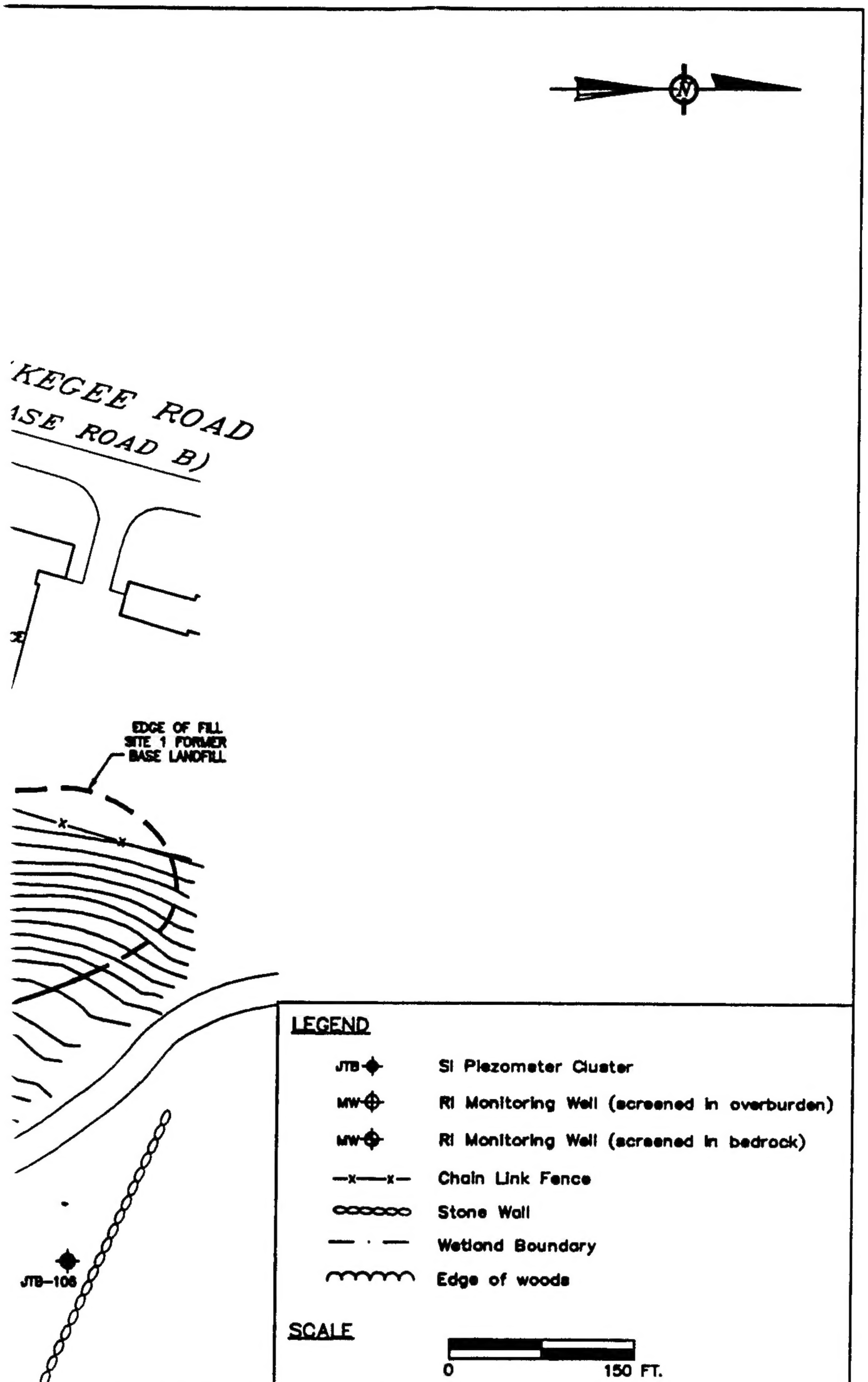
SCALE: 1 IN. = 1

DATE: APRIL 24, 1997

JOB NO.

SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS

SHEET 1



ANEPTEK CORPORATION Analytic, Environmental and Process Technologies ...st Central Street, Natick, MA 01760	TITLE	FIGURE 7–2 PRELIMINARY CONCEPTUAL GRADING PLAN NEW YORK STATE GEOMEMBRANE COVER STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK

...PROVALS	DATE	PREPARED FOR	SCALE
[illegible]	5/2/97	NATIONAL GUARD BUREAU	1 IN. = 150 FT.
m.P.	5/2/97	DATE: APRIL 24, 1997	JOB NO.
m.P.	5/2/97	SOURCE: GREVAS & HILDRETH, P.C. LAND SURVEYORS	SHEET 1 OF 1

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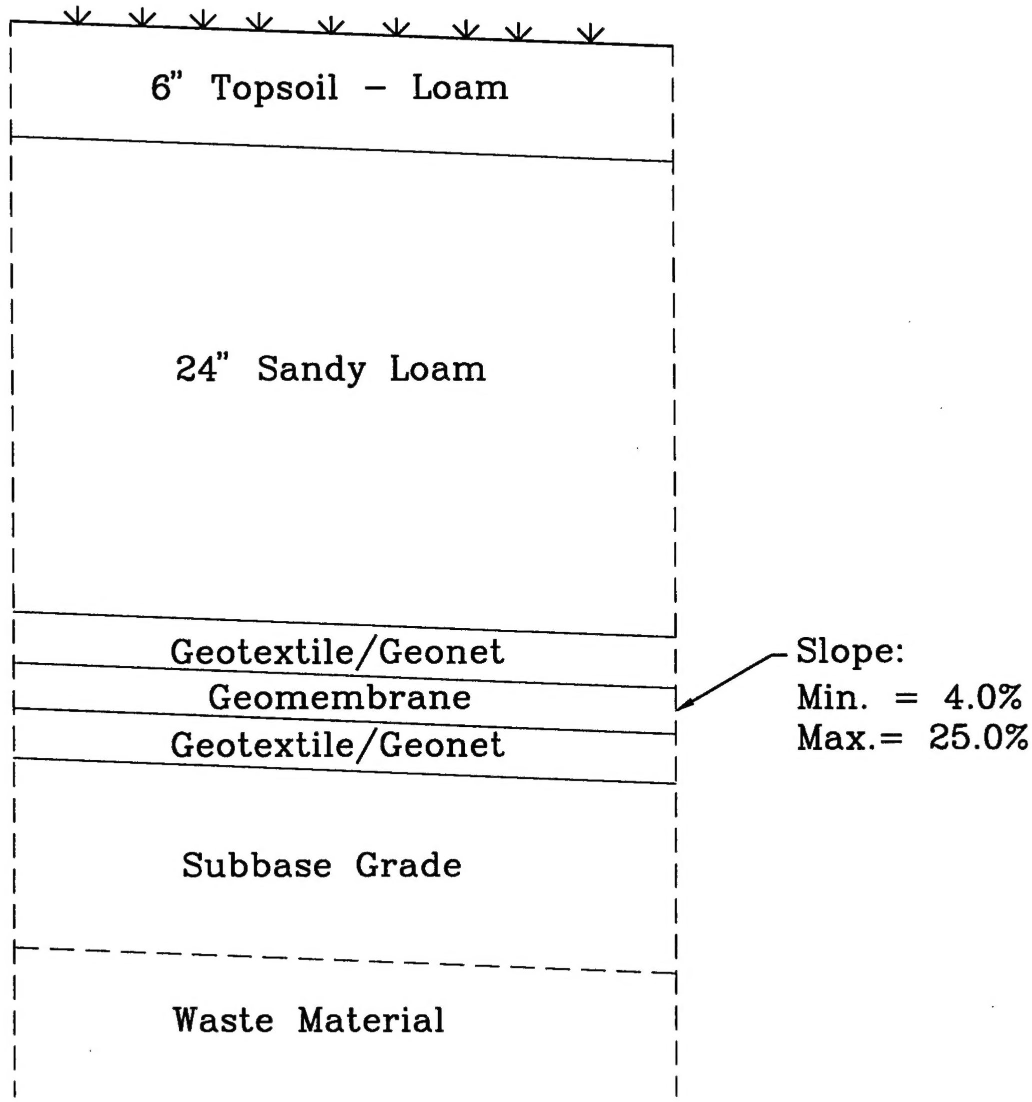

PREPARED FOR NATIONAL GUARD BUREAU	ANEPTEK CORPORATION Analytic, Environmental and Process Technologies 209 W. Central Street, Natick, MA 01760	TITLE FIGURE 7-3 TYPICAL CROSS SECTION VIEW MEMBRANE COVER
DATE APRIL 16, 1997 / SCALE		STEWART AIR NATIONAL GUARD BASE NEWBURGH, NEW YORK
SOURCE		

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SECTION 8.0

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